CANADA
DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH
Hon. W. Templeman, Minister; A. P. Low, Deputy Minister;
R. W. Brock, Director.

THE COAL FIELDS OF MANITOBA, SASKATCHEWAN, ALBERTA, AND EASTERN BRITISH COLUMBIA

BY

D. B. DOWLING

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST
EXCELLENT MAJESTY
1909

No. 1033.

COAL CREEK, FERNIE, B.C., 1898

Photo., G. M. Dawson

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To R. W. Brock, Esq.,
Director Geological Survey,
Department of Mines.

Sir,—I beg to submit the following report on the coal fields of Manitoba, Saskatchewan, Alberta, and eastern British Columbia.

I have the honour to be, Sir,
Your obedient servant,

D. B. DOWLING.

April 20, 1906.

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THE COAL FIELDS OF MANITOBA SASKATCHEWAN, ALBERTA, AND EASTERN BRITISH COLUMBIA.

BY

D. B. DOWLING.

INTRODUCTION.

This report is intended as a concise statement of the area and probable contents of the various coal fields of the middle portion of Canada. In its preparation, many published reports giving details of the thickness of seams and character of the enclosing rocks have been consulted, and references to these added; so that they may be further studied. No attempt is here made to treat the subject in detail, except as regards the character of the coal.

The analyses already published are scattered throughout many reports and an effort has been made here at a compilation of this material, in the form of tables of analyses; while for the purpose of comparison, other North American and foreign coals have been added.

Location and Area.

In Manitoba, the coal-bearing rocks occupy a small area in the southern part, underlying an elevated portion called Turtle mountain. Thin seams outcrop around the base of this hill, and it is probable that others may be found higher up its slopes. With our present knowledge we can define an area of about forty-eight square miles near the western end of this hill as being available for mining.

The Saskatchewan areas lie principally in the southern part, and are being mined on the Souris river. The elevation known as the Coteau is also composed of coal-bearing rocks, which continue westward in the Wood mountains and Cypress hills. This area, although not well prospected, contains possibly 4,000 square miles within which coal may be found. Between the two branches of the Saskatchewan river there is an area of possible coal-bearing rocks; but the horizons having good workable seams farther west, appear in this area to be rather poorly supplied, so that the value of this part as a coal field is problematical.

The Province of Alberta, as will be seen from the accompanying map, is liberally supplied with coal areas. The western border of the southern part of the Province consists of several ranges of mountains, formed generally of rocks which were originally the floor on which the coal formations were laid down. The elevation of the coal formations subjected them to greater denudation than the harder rocks beneath, consequently little of this material is left; but in the wider valleys remnants are still found. These, from the superior quality and amount of coal, form very valuable

coal fields. The foothill belt, although not well prospected, will be found to contain many valuable areas in which a softer grade of coal may be found.

East of the foothill area, lies a great extent of coal-bearing rocks which are comparatively undisturbed. The coal in this region is well suited for domestic use; and as it is within the settlement belt, where wood is scarce, a demand for it is assured. These areas are delineated on the map, and may be referred to as the Edmonton coals. They extend north from near the International Boundary to near the Peace river, covering an area of at least 10,000 square miles.

Another coal formation occupies the southeastern border of the Province, with an area of 5,000 square miles; the seams in this are of more value in the southern portion than farther north, or east. The principal mines of this area are to be found near Lethbridge.

The eastern British Columbia areas are discussed in connexion with the foregoing, principally on account of their importance; but also from the fact that, their structure is intimately related to that of the Alberta areas within the mountains. The valley of Elk river, which heads near the source of the Kananaskis, and occupies the same valley as the upper part of the latter stream, has exposures of coal-bearing rocks of the same horizon as those being mined in Alberta, at Canmore, Bankhead, Blairmore, and Coleman.

Historical Summary.

Many of the published accounts of pioneer journeys contain references to the presence of coal seams. This was to be expected from the fact that, many of the exposures on the stream banks were plainly in view, and some of them were probably on fire.

The earliest mention of coal in the central part of the continent was, probably, that by Sir Alexander Mackenzie in 1789; of a coal seam on Great Bear river in the north. In the eastern part of Canada, under the French occupation, coal was mined before this time, near the mouth of Salmon river in New Brunswick.

The earliest intimation of the area under discussion is probably that which is to be found on a map furnished by Arrowsmith, for Mackenzie's voyages through North America, published in 1801; and a later edition by Arrowsmith published in 1811, on which is shown Peter Fidlers route across the plains, in 1793. These both show that coal had been observed on the Red Deer river, somewhere near the mouth of the Rosebud.

David Thompson, one of the early pioneers, in 1800 made a trip from Rocky Mountain House down the Saskatchewan, and noted the coal seams; but his journal is still unpublished.[1] Alexander Henry, trading for the North West Company, records coal at Rocky Mountain House, and mentions seeing in 1811, during his journey down the river, the thick seam near Goose encampment: which he estimates at about 30 feet in thickness.[2]

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[1] Annual Report Geo. Surv., Can., Vol. II., p. 8 E.

[2] New Light on the Early History of the Greater North West, by Elliott Coues, Vol. 88, pp. 702 and 741.

The coal at Edmonton was noted by Sir George Simpson, in 1841;[1] and ten years later, Sir John Richardson obtained specimens, and considered them to be of the same horizon as the coal on the Mackenzie river.[2]

Father De Smet crossed the mountains from the westward in 1845, passing Rocky Mountain House. In the foothills, or in the vicinity of the mountains, coal was seen on some of the streams—probably branches of the Red Deer river.[3]

In 1857, Sir James Hector found coal at Souris river near the present mines. In 1858, he described the coal at Edmonton, and also that on the Red Deer river south of Edmonton: remarking that the coal at Edmonton was in use in the forges, and had proved satisfactory. In 1860, he saw the coal seams on the Athabaska and on the Pembina near where the Grand Trunk Pacific railway crosses that stream.[4]

In 1863, Lord Milton and Dr. Cheadle recorded the use of coal in the forges at Edmonton, from the seams in the river bank, and also mention seeing thick coal seams on the Pembina.[5]

Dr. Grant in "Ocean to Ocean"—the record of Sir Sandford Fleming's trip across the continent in 1872—also refers to the Edmonton and Pembina coals, and to the reported occurrence of vast beds of coal on the Brazeau.

In 1873, Dr. A. R. C. Selwyn descended the Saskatchewan, and recorded in much greater detail the coal seams on this river. This is the first report by an officer of the Canadian Government. It is accompanied by a report on the coal of the Dirt hills in Saskatchewan, by Dr. R. Bell.[6]

Discoveries of coal near the International Boundary were made during the progress of the survey of this line. Attached to the commission as naturalist, was Dr. G. M. Dawson, who reported very fully on the geology of the country, and paid special attention to the evidences of coal underlying the plains. The coal at Roche Percee, discovered in 1857, was fully reported upon, and analyses made. In the vicinity of Milk river, small coal seams were noted for the first time.[7]

The coal seams at Blackfoot crossing were recorded by Prof. John Macoun in the report of the Canadian Pacific Railway survey for 1879.

Earlier Mining.

Previous to the advent of the railway there seems to have been very little attempt at mining, although it is believed that about the year 1880

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[1]Narrative of a Journey Round the World, 1841-2, by Sir George Simpson, Vol. I., p. 101.

[2]Journal of a Boat Voyage through Ruperts Land, p. 195.

[3]Oregon Missions, by Father P. J. De Smet, New York, 1847, pp. 150-160.

[4]Papers relative to the [illegible]oration, by Capt. Palliser, London, 1859, pp. 22, 25, 44.

Further Papers relativ[illegible]e Exploration by Capt. Palliser, London, 1860, p. 25.

[5]The North West Passage by Land, by Milton and Cheadle, London, 1865, p. 201.

[6]Report of Progress, Geol. Surv. Can., 1873-74. pp. 16-87.

[7]British North American Boundary Commission. Report on the Geology and Resources of the Region in the Vicinity of the Forty-Ninth Parallel, by G. M. Dawson, Montreal, 1875.

some coal was shipped by barge from Roche Percee down the Souris; but the venture was probably not very successful.

Subsequent development in coal mining followed railway extension very closely. In 1888, coal was discovered near Banff, on the Cascade river, opposite the present Bankhead mines. Mining here was, however, discontinued as soon as the seams were discovered near the railway at what was afterwards called Anthracite. This mine was leased in 1891 to H. W. McNeil & Co., who continued mining until 1904.

The coal mines at Lethbridge were preceded by primitive attempts at mining from the banks of the river. After a company was formed and plant erected the industry began to assume importance, and shipment may be considered to have commenced about the year 1886.

The well established mining industry at Canmore commenced about 1888, at what is known as the Cochrane mine, a mile up the river from the present slope. In 1891 the Canadian Pacific railway built a spur down the river to the mouth of the gully opposite White Man pass, where the present mining plant is installed. An extension south to the Sedlock prospect was finished in 1907, thus opening another new mine.

A mine near Cochrane was opened in 1885, known as the Bow River mine. This was closed in 1888, and another opening made nearby for a new company; but for many years this has been closed.

Near Medicine Hat, the coal seams on the Saskatchewan have been mined since 1883. The most prominent are in the neighbourhood of Stair.

The Crowfoot seams were worked in a desultory manner by the Blackfoot Indians, and for a time the Canadian Pacific railway made attempts at mining on Crowfoot creek, north of the railway, commencing operations in 1888.

The progressive development of the Edmonton mines closely followed the growth of the settlement. With the advent of the railway they rapidly increased in importance, and by consolidation, and increase of capital, their operations were placed on a more permanent basis.

Kneehills mines were opened in 1893, but as they are far from a railway, they have—by the primitive means used—taken out only enough coal to supply the immediate settlers.

The greatest amount of mining has been along the line of the Crows Nest branch of the Canadian Pacific railway, in the mountains. This followed immediately on the completion of the railway, and practically within recent years.

In Manitoba, there was promise at one time of a mine at the west end of Turtle mountain, south of Goodlands. About 1890, several holes were bored, and a shaft put down; but for some reason the industry was discouraged. South of Deloraine, coal has been taken from a couple of thin seams for several years, but there has been no continuous mining.

Summary, and Conclusions.

The geological structure of the area was roughly outlined by Sir James Hector, but to Dr. G. M. Dawson, R. G. McConnell and J. B. Tyrrell fell the lot of making the detailed examinations which gave us a true

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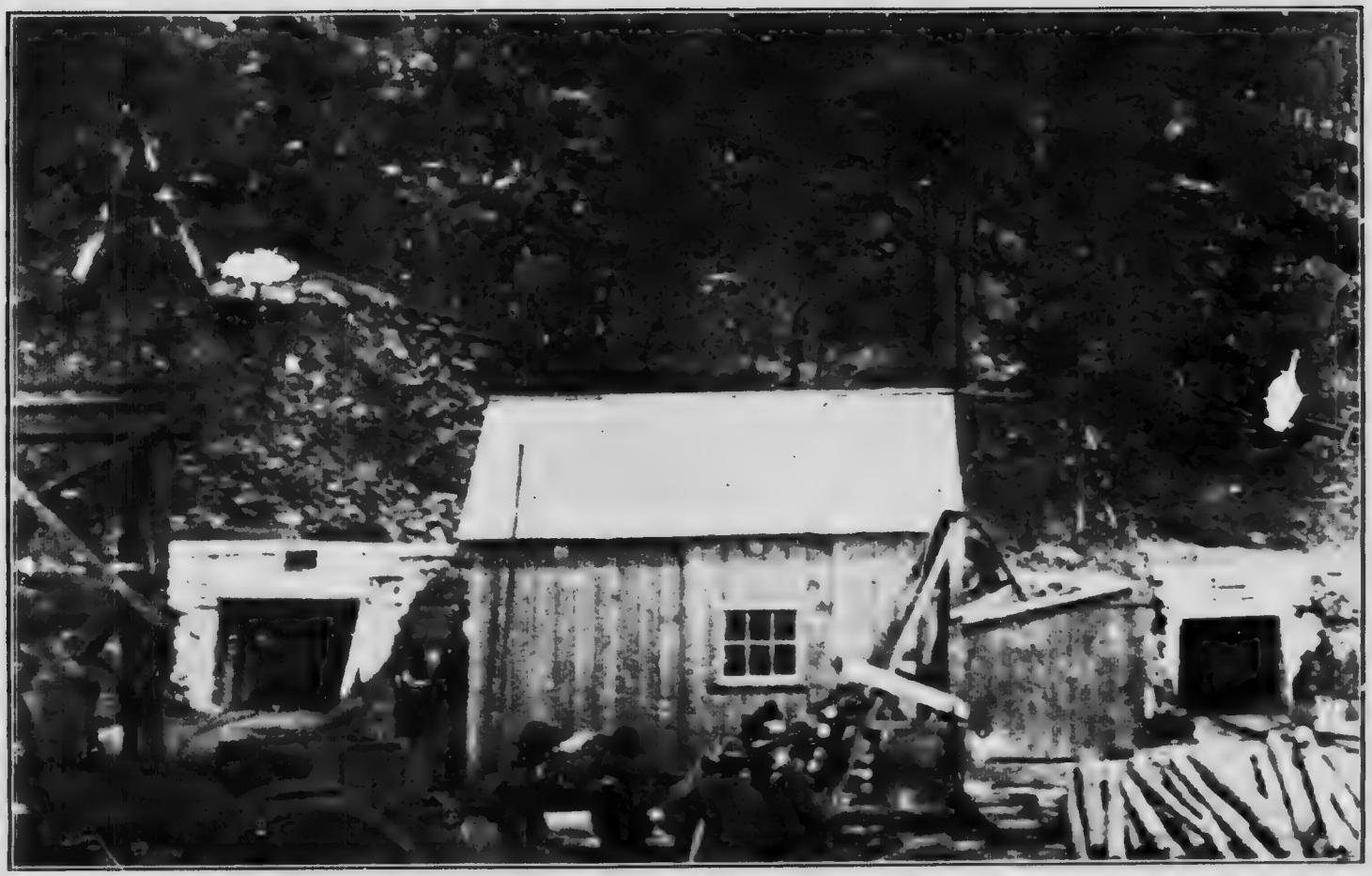

First Openings at Bankhead—Seams 1 and 2, 1905. Photo., D. B. D.

Sheds and Power Plant, Bankhead, 1906.

insight into the structure and areal distribution of the measures. The coal is found in three distinct horizons in the Cretaceous, separated by shales of marine origin. The lowest is practically the base of the formation, and is considered Cretaceous from its fossil flora; though it lies just above the Fernie shale, now understood to be of Jurassic age. The line of demarcation is not very sharp, as the shales in their upper part become interstratified with sands, and gradually pass into a sandstone formation containing coal seams—called by Dawson the Kootanie. The age of the Kootanie, if not Jurassic, must be early Cretaceous. Above this the Dakota does not appear to be coal-bearing in an economic sense, and not until near the top of the Belly River or Judith River formation is reached does there appear to have been land conditions of sufficiently long duration for the growth of material to form coal beds. The coal horizon in the Belly river contains but a few workable seams; but its areal distribution makes it important. The third coal horizon is at the top of the Cretaceous, and includes part of the old Laramie formation. The upper part in Alberta is a fresh-water deposit, and is classed as Tertiary, under the name Paskapoo formation, and is not distinctly coal-bearing. What is believed to be the same horizon as the lower Laramie, bears many lignite seams, and in Alberta is given the name Edmonton formation, the h[illegible] member of the Cretaceous.

The three coal horizons are as below:—

(1) Edmonton formation in Alberta, and Laramie in Saskatchewan.
(2) Belly River (Judith River) formation.
(3) Kootanie formation.

Estimates of Area and Coal Content.

The problem of forming an estimate of the coal content is exceedingly difficult, and the aim in this review is to give what might be called the maximum value from the knowledge we at present possess. The minimum will be arrived at only after years of prospecting, and will, we hope, be well up to the present estimate.

In the small rich areas in the mountains the measures are best exposed, so that from these a better estimate of coal content can be made—a much closer one than in the case of flat lying measures, having exposures of coal seams at great distances apart, with few drill holes to prove the intervening portions. On the plains, so little is the evidence of disturbance of the beds that, a large area in the vicinity of a heavy seam may reasonably be classed as workable. If, however, the area depends for coal on one seam alone, there is a constant danger that it may taper off in thickness, or split up into unworkable seams by an increase in the partings

A low estimate of the general content is, therefore, to be placed on the areas outside the mountains; and even this in the end may prove excessive.

For limited areas where heavy seams are known—as in the country south and west of Edmonton—the estimate is probably low enough, but in the less explored areas the estimate may be too high.

The Saskatchewan areas of the southern part may produce sufficient

coal to warrant the estimate put on them; but the content of the portion northeast of Medicine Hat is problematical, since few seams have as yet been found.

Coals of the Formations.

Kootanie Formation: Areas and Coal Content.

Eastern British Columbia. Exposures of these measures are to be found in the Elk River valley, which heads near the Kananaskis. The field, which has been generally known as the Crowsnest area, contains 230 square miles of coal lands estimated to contain 22,000,000,000 tons of bituminous coal. North of this, on the upper waters of Elk river, an additional area of 140 square miles has an estimated content of 14,000,000,000 tons.

Alberta. The Kootanie coals in Alberta are generally exposed in narrow bands in the mountains. These are here enumerated in order from the south:—

Coleman area is estimated at 45 square miles, with 50 feet of coal in the section, giving an estimated content of 2,000,000,000 tons.

Blairmore-Frank area is irregular in shape, and broken by faults and folds; but assuming for it an area of 50 square miles, with an estimated thickness of 30 feet of coal, its total content is estimated at 1,500,000,000 tons.

Livingstone area lies north of Blairmore, and west of the Livingstone range of mountains. The area containing coal approximates 60 square miles. A maximum estimate of its coal content is 1,500,000,000 tons.

Moose Mountain area, lying outside the first range of the Rocky mountains, consists of a narrow band encircling this outlying mountain. It extends from near the main line of the Canadian Pacific railway, south to Sheep creek. Its area is estimated at 15 square miles, with a thickness of 15 feet of coal in the section. This would give a probable coal content for the area of 150,000,000 tons.

Cascade area is a long strip between the ranges, containing workable seams for about 40 miles of its length. It is estimated to contain about 400,000,000 tons of anthracite, and of the softer grades 1,200,000,000 tons.

Palliser area, on Panther river, is comparatively small, but with an area of perhaps six square miles has, possibly, a coal content of 20,000,000 tons.

Costigan area lies east of Palliser, and is estimated in 12 square miles to possibly contain 60,000,000 tons—mostly bituminous coal.

Bighorn area, between the Saskatchewan and Brazeau rivers, is estimated at 60 square miles, with a content of at least 1,460,000,000 tons.

Belly River Formation: Area and Coal Content.

The coals that belong to this horizon, grade generally between lignite and bituminous, and are found over an enormous area. Roughly

PLATE IV

FIRST OPENINGS AT BANKHEAD—SEAMS 1 AND 2 1905

Photo. D. B. D.

SHOPS AND POWER PLANT, BANKHEAD 1906 Photo., D. B. D.

measured on the map, this area is about 25,000 square miles. An estimate on this basis would, however, be very misleading; since portions are known to be either unproductive, or, to contain only small seams of inferior coal; 5,000 square miles might be assumed as being reasonably valuable. Four feet of coal underlying this area would furnish 13,000,000,000 tons. Most of the productive value is in Alberta. The amounts contained in the two provinces, respectively, may be estimated at 10,000,000,000 for Alberta; and 3,000,000,000 for Saskatchewan.

The Edmonton Formation: Area in Alberta.

The coals of this formation are generally lignites; but in the foothills grade up to bituminous. The foothill areas, though but narrow bands, have a length of about 400 miles, and thus may have an exposed area of possibly 2,000 square miles. This has been estimated to have possibly 11,000,000,000 tons as a total content.

The eastern outcrop produces lignites that, in some places are almost lignitic coals. The area is enormous, and only that portion between the Bow river and Edmonton is included in the estimate. This embraces a surface of 10,800 square miles, which is estimated to have 6 feet of coal below it—at a workable depth. Deduced from these premises the possible content would be 60,000,000,000 tons.

The total for the formation is, therefore, an area of 12,800 square miles, and a coal content of 71,000,000,000 tons.

The Laramie Formation: Area in Saskatchewan.

The coals of this formation are all lignites. The Souris area, of eight townships, is estimated to contain 2,000,000,000 tons; while the remaining portion lying to the west—consisting of 4,000 square miles—has possibilities up to about 13,000,000,000 tons: a total for the area of 15,000,000,000 tons.

The Laramie Formation: Area in Manitoba.

The Turtle Mountain area in the southern portion of the Province has an available area of 48 square miles, probably coal-bearing, which with 4 feet of coal, represents a possible total of 160,000,000 tons.

Estimate of Total Content.

	Square Miles.	Million Tons.	
Eastern British Columbia.	370	36,000	Bituminous.
Alberta:—			
Coleman area.....	45	2,000	do
Blairmore-Frank.....	50	1,500	do
Livingstone.....	60	1,500	do
Moose mountain.....	15	250	do

	Square Miles.	Million Tons.	
Cascade	40	1,200	Bituminous and Anthracitic.
do	....	400	Anthracite.
Palliser	6	20	Bituminous.
Costigan	12	60	do
Bighorn	60	1,400	do
Belly River area	3,500	10,000	Lignitic and lignite.
Foothills	2,000	11,000	Coal and lignitic.
Edmonton formation	10,800	60,000	Lignite.
	16,588	89,330	

	Square Miles.	Million Tons	
Saskatchewan:—			
Laramie	4,000	15,000	Lignite.
Belly River	1,500	3,000	do
	5,500	18,000	Lignite.
Manitoba:—			
Turtle mountain	48	160	Lignite.

The total estimate for these three provinces, and the eastern part of British Columbia approximates 22,506 square miles, and 143,490,000,000 tons of coal.

In this total the various classes of coal occur in the following proportions:—

Anthracite	400,000,000 tons.
Anthracitic and semi-anthracite	860,000,000 "
Bituminous and some semi-anthracite	43,070,000,000 "
Coal and lignitic coal	21,000,000,000 "
Lignite	78,160,000,000 "
	143,490,000,000 "

Notes on the production of coal.

Eastern British Columbia.—The mines of the Crowsnest district began shipping in 1899. The demand for a steam and coking coal for the mining districts of the western states, and British Columbia, caused a rapid increase in the output in a few years. Coal for railway use has been extensively drawn from this field. A summary of the amount mined for nine years is subjoined:—

Output of Mines.		Home Consumption.			Export to United States.		
Year.	Tons.	Coal.	Coke.	Equivalent in Coal.	Coal.	Coke.	Equivalent in Coal.
1900.....	230,000	92,519	27,065	41,202	7,968	38,958	55,056
1901.....	379,355	125,725	77,241	112,638	72,862	32,121	68,135
1902.....	393,961	125,327	81,973	125,995	101,776	26,764	41,162
1903.....	589,888	194,325	122,006	203,291	145,010	27,757	46,260
1904.....	662,685	210,980	119,004	197,673	118,188	97,690	153,227
1905.....	831,933	188,103	45,044	223,144	246,022	113,337	174,684
1906.....	720,449	185,541	134,646	217,170	230,863	53,400	86,875
1907.....	876,731	262,451	140,987	234,200	291,410	59,890	88,670

The shipments for 1908 will include the output of a new mine at Hosmer.

Alberta and Saskatchewan.—The output of the mines of these two provinces, taken from census reports and the provincial returns, shows a great increase in the period between 1901 and 1906:—

	Production of Coal in Tons.			
	1881.	1891.	1901.	1906.
Alberta.....	1,590	174,131	280,000	1,385,000
Saskatchewan.....			40,909	170,582
	1,590	174,131	320,909	1,555,582

This rapid rise in the rate of production suggests that, it must be due not only to increase in population, but also to the extension of railways and the introduction of manufacturing industries. This is borne out by the population returns covering the same period:—

	Population.			
	1881.	1891.	1901.	1906.
Alberta.....	18,075	26,277	68,376	185,412
Saskatchewan.....	19,679	40,522	90,564	257,763
	37,754	66,799	158,940	443,175

The above table shows that, the coal consumption is increasing at a

much more rapid rate than the population. In considering, therefore, the future needs of the northwest provinces, it is quite evident that in a few years—unless new mines are opened—the present plants will be taxed to their full capacity.

The first need of the population is domestic fuel, and much of this is being supplied from the lignite belt. Transportation and manufacture next demand fuel for power production. Thus the per capita coal consumption will increase with added population.

The coal available in Alberta is of all grades, from lignite to anthracite, and mines producing each kind have been opened up. In Saskatchewan the lower grades only have been found.

GENERAL CHARACTER OF THE DISTRICT.

Topography.—The topography of the district included within the provinces discussed in the following report, consists of many diverse types, due both to structure and erosion. The most prominent feature is the Rocky mountains. This series of ranges, as will be seen from maps of such areas as the Crowsnest or Cascade coal fields, is merely a series of inclined blocks of the harder rocks upon which the softer Cretaceous beds have been laid.

They present a rugged outline and steep faces from weathering and glacial erosion; but their topographic features do not indicate great age, as is shown by the close connexion between their structure and present form.

The three provinces to the east of the mountains, although generally called plains, are in reality undulating table lands, which may be divided roughly into four topographic divisions:—

The first consists of a plain lying upon the Archæan floor, from which all but the Palæozoic rocks have been removed; and in Manitoba this is smoothed over by deposits of glacial drifts and by the sediments laid by the glacial lake Agassiz.

The second is a plateau which has for its eastern edge the northeastern escarpment of the Cretaceous shaly deposits.

The third division is more diverse in character; but is roughly outlined on its eastern edge by the elevation known as the Coteau. The rocks which are exposed throughout this division have a larger proportion of sandstones among them than in the second. To this, no doubt, is due the greater relief in the topography.

The fourth division may be called the foothills area, and the character of its topography is due more to structure than to drainage denudation. The foothills consist generally of ridges of inclined strata running parallel to the Rocky mountains, cut through at intervals by stream valleys.

First division.—This is the lowest in elevation and is essentially a region of lakes, with the exception of the southern end, which is covered by silts and clays of lacustrine deposition—now forming the fine farming lands of southern Manitoba. The drainage is northward to the Nelson river, which flows to Hudson bay. The surface features east and north of Lake Winnipeg differ from those to the west in that this eastern part

Photo., G. M. Dawson

PHOTOGRAPH SHOWING THE GENERAL RELIEF OF THE COUNTRY BETWEEN THE FOOTHILLS AND LAKE WINNIPEG, FROM A MODEL BY D. R. DOWLING
WOODED COUNTRY SHADED

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is mostly of the mammillated character usually found in a country underlain by Archæan rocks, with but a thin mantle of surface drift.

Second division.—The second topographic division consists of a plateau formed of shales and other soft rocks. The surface has suffered great denudation, so that its general elevation is hard to estimate; but a large portion of the area is nearly 1,000 feet above the level of the Manitoba lakes. Several valleys have been eroded through the escarpment. The wider openings are those through which flow the Assiniboine and Saskatchewan rivers, whose valleys, back from the face of the escarpment, show as deep narrow cuts with frequent scarped banks. The eastern edge of this plateau between the indentations formed by drainage channels forms the elevations known as the Pembina, Riding, Duck, Porcupine and Pas mountains.

In this division the drainage is divided between the general eastern drainage of the Qu'Appelle, Assiniboine and Souris waters, and the northeastern drainage of the Saskatchewan.

Third division.—This, extending from the Coteau to the foothills, may be considered as consisting of three sloping planes from which its recent topography has been derived. The dividing lines between these three planes are: the watershed between the two branches of the Saskatchewan, and the valley of the Belly river. North of the watershed mentioned, the country slopes generally from the mountains northeasterly, and is drained radially by streams that run to Hudson bay and the Mackenzie valley. South from this the slope is southeastward to the depression occupied by the Belly river. Southward again the slope changes to nearly east; but following the valley of the South Saskatchewan we find north of the Cypress hills and Wood mountains a slope to the north.

On these plains the relief is very much accentuated by the fact that, much of the country is bare of timber; but elevations such as the Cypress hills, standing 2,500 feet above the level of the railway at Irvine, or the Hand hills, which are 800 feet above the surrounding plain, become pronounced topographic features.

Fourth division.—The topography of the foothills is much more diverse than that of the other three previously discussed. From the south the foothill area gradually widens to the north, and in the valley of the Crowsnest river, as it emerges from the mountains, the erosion has narrowed the foothill belt to a few miles.

The illustration (Plate VI)—introduced to show the chief features of the topography—is from aphotograph of a model in which the relief is exaggerated somewhat to bring out the less prominent hills and valleys. It also has a bearing on the fuel problem. The southern part is mostly bare prairie with a fringe of true forest—shown in the picture as a darker shaded portion—along the north, and covering most of northern Manitoba. Park-like, partly open patches of poplar and some spruce, invade the prairie section from the forest edge. About half the area illustrated is true prairie, where the fuel supply for the settler will be local coal.

Communication.—The natural means of communication by waterways is restricted to the navigation of some of the lakes in Manitoba, and the streams crossing the plains. The streams are navigable only

at high water; and they all have strong currents; hence the difficulties of navigation from shallow water and current combined are so great that overland transport is necessary. This is being supplied by the railway lines which traverse the area generally in an east and west direction. The main line of the Canadian Pacific railway was the first through line connecting the eastern and western adjacent portions of Canada. It crosses the Rocky mountains by the Bow River valley through the Kicking Horse pass. Subsequently, branches from St. Paul to Moosejaw, and from Medicine Hat to Kootenay Landing passed through the coal mining districts of Souris river and the Crowsnest pass. Two transcontinental lines now building - the Canadian Northern and the Grand Trunk Pacific—reach from Winnipeg to Edmonton. A third line a branch of the Canadian Pacific—will shortly be completed to the same point. Transverse roads are also included in the present general scheme: such as the railway from Edmonton to Calgary; that from Calgary to McLeod; and McLeod to a connexion in Montana. Another transverse route is provided by the Canadian Pacific and Canadian Northern branches from Prince Albert to Portal, on the Dakota boundary. The third set of transverse roads includes a number in Manitoba. An outlet to Hudson bay is also being located from the lower part of the Saskatchewan.

The metallurgical market in Canada is at present British Columbia; the foreign—which may be supplied from this coal area—is in the United States, immediately to the south. The areas crossed by the Crows Nest branch supply coking coal, and several of the collieries are making coke. On the main line of the Canadian Pacific railway, no coking coal is being mined. Farther north, the new transcontinental roads will build branches to reach possibly the coking coals of the areas near the Saskatchewan river: to supply the market that will be created by the opening of northern British Columbia.

For railway power the supply will have to come from the vicinity of the mountains, and this can only be obtained—for amounts above the present available tonnage—by a larger output from the mines on the railways crossing the mountain coal areas; or by running branches to other available areas. The Ohio coals can be shipped via the lake route, and compete with the western coals as far as the western border of Manitoba.

For domestic and manufacturing purposes the coals of the plains will maintain their market against the higher grade coals of the foothills, and mountains; because of the shorter haulage to market, and their relative cheapness. For power stations, the lignites have been demonstrated to be admirably adapted for gas producers; and as they are to be found very near the area which is expected to soon have a large population, the market for this class of fuel is assured. The extension of railways through the fertile, treeless areas cannot of itself cause permanent settlement: reasonably cheap fuel is also necessary. The western portion of Saskatchewan is being crossed by railways, several of which cross the treeless area: but as they are being constructed mainly from the east, permanent settlement will follow only when these branches cross the Alberta coal areas, and render the coals available for a fuel

supply. Coal mining in the vicinity of Edmonton is just now changing. Hitherto, the demand has been purely local; but now—owing to the advent of railways—shipments are being made to distant parts; which has necessitated better equipment, and the installation of additional machinery to the existing plants.

In Saskatchewan, the southern coal area is crossed by the "Soo" branch of the Canadian Pacific railway, and one from Estevan eastward to Manitoba. The facility with which this lignite can be marketed, both north and east, together with the increase in population, has raised the production of the mines on the Souris from about 40,000 tons in 1901, to over 100,000 in 1906.

Activity in mining for the domestic market is generally greatest during the autumn and winter months; but this period also constitutes the busy season for the railways, hence there is often difficulty in securing the necessary cars. If it could be arranged that coal could be stored under cover during the summer months, coal famines would not occur.

GENERAL GEOLOGY.

General Statement.

At the eastern edge of Manitoba, and extending northwesterly, appears the old Archæan plain on which, to the southwestward, is laid successive beds of Palæozoic limestones, in their turn covered by heavy deposits of shales and sandstones, mainly of Cretaceous age; though remnants of Tertiary deposits are found on this Cretaceous plateau. The Palæozoic rocks which disappear under this mass of shales along its eastern edge appear again in the Rocky mountains by faulting, and their load of softer rocks is there almost all removed, leaving traces only of the lower members in some of the valleys.

The formations exposed in this part of the continent, therefore, range in age from the rocks of the Archæan complex, through the Palæozoic and Mesozoic to the Cenozoic. As before remarked, lying on the Archæan floor in Manitoba are exposed limestones correlated with the Ordovician and Devonian of other parts of the continent. These consist mainly of dolomitic beds that are flat lying, and form inconspicuous topographic features. In the Rocky mountains, in addition to this series, limestones and calcareous shales of Carboniferous age occur.

The Mesozoic section is complete only in the vicinity of the mountains. The lower beds—red sandy shales—have been found north of the Saskatchewan to contain Triassic fossils. This red series is in turn covered by dark shales of marine origin, with fossils of a Jurassic type. They are everywhere found beneath the lowest coal measures, which are assigned to the Cretaceous, and form narrow beds running parallel to the ranges. No exposures of these Jurassic rocks are known east of the foothills.

TABLE OF

	GLOBUS	ALBERTA	SASKATCHEWAN	MANITOBA
Tertiary	Miocene	Miocene	Miocene	
	Eocene	Paskapoo		
			Laramie	Eocene
		Edmonton		
Cretaceous	Montana	Bearpaw	Pierre-Lea Creek	Odanah
		Belly R	Belly R	
		Cleggett		Millwood
		Eagle		
	Colorado	Colorado		Neebing
		Carlisle		
		Benton		Benton
	Dakota	Dakota		Dakota
	Kootanie			
		Kootanie		
Jurassic		Fernie		
Triassic		Banff Shale		
Carboniferous		Rundle Lime		
Devonian		Intermediate Series		Manitoban Winnipegosan

FORMATIONS

Montana	Dakota	Kind of Rocks	Character of Fossils	Economic Value
		Conglomerates and sandy clays	Land and fresh water	
Laramie	Laramie	Sand-stones and clays	Fresh water	Building stone
Foxhill	Foxhill	Sand-stones and clays	Land plants. Brackish water	Coal
Bearpaw	Pierre	Shales	Marine	
Judith R.		Sand-stones	Brackish and fresh	Coal
Claggett	Pierre	Shales	Marine	
Eagle		Sandstones	Marine	
Niobrara	Niobrara	Calcareous shales	Marine	
	Greenhorn			
Benton	Benton Graneros	Shales	Marine	
Dakota	Dakota	Sandstones	Fresh water	Some coal
Cascade Kootanie	Fuson Minnewaste Dakota Morrison	Sandstones and shales	Land plants	Coal
Ellis	Unkpapa Sundance	Shales and sandstone	Marine	
	Spearfish	Red shale	Marine	
Quadrant	Minnelusa	Limestones and quartzites	Marine	Lime and cement
Madison	Pahaspa			
Monarch		Limestone	Marine	Lime and cement

The lower Cretaceous consists of sandstones, and brown and black shales, in which are numerous coal seams. These rocks do not appear east of the foothills. The thickness of the formation increases westward, and is at its maximum in the Elk River valley, where it has a thickness of about a mile.

The middle part of the Cretaceous, consisting of shales of marine origin, forms the plateaus extending from the mountains to within the borders of Manitoba. The general topography, with its deep incised valleys, is derived mainly from the erosion of these soft rocks.

The upper part of the Cretaceous section, although for the most part marine shales, grades upward to sandy measures of brackish water origin. The harder beds of this upper part form many of the strong topographic features, both of the foothills and plains. Few exposures are found in the mountains, where they have been almost entirely removed by erosion.

The Tertiary rocks are littoral deposits sandstones with some shales and conglomerates. Exposures are to be found in the higher plateaus such as the Cypress hills and Wood mountain, and in the trough which extends north from the International Boundary in the foothills, including the Porcupine hills, and the sandstones at Calgary. The northern extension crosses the Saskatchewan west of Edmonton.

The later deposits, such as the glacial till and the Saskatchewan gravel, will be but briefly mentioned. The glaciation of the mountains spreads a mantle of till through the foothills. The till of the Keewatin glacier does not always reach the eastern margin of the Rocky Mountain till, and they are possibly of two distinct periods. The eastern derived till is thin on the uplands, and often appears to have been rearranged by deposition in water. Morainic deposits occur on the Coteau in eastern Saskatchewan, and in Manitoba. Glacial lake phenomena have been observed at several parts; but the Lake Agassiz beaches of Manitoba, and the upper Red river, have formed the subject of several interesting reports.

Summary Description of Formations.

Devonian

In Manitoba, the Devonian rocks are divided into three series, Upper, Middle, and Lower.

Upper Devonian or Manitoban

Light grey, hard, brittle limestone with red argillites at base thickness about 200 feet.

Middle Devonian or Winnipegosan

Light yellow, hard dolomite, with porous beds beneath thickness about 200 feet.

Lower Devonian

Mainly red shales thickness about 100 feet. These beds probably represent only the upper part of the lower Devonian of eastern America.

In western Saskatchewan these beds may be found near the Churchill river; having nearly the same characters.

In Alberta, the most eastern exposure is in the neighbourhood of Athabaska river. In the Rocky mountains they form the *Intermediate series* described by R. G. McConnell as being brownish, irregularly hardened dolomites, and greyish, crystalline dolomites, with some sandstones and quartzites.

Carboniferous

As will be seen by the table, these rocks are found in South Dakota, Montana, and Alberta. They are not exposed in Manitoba or along the northwest margin of the Cretaceous plateau, but are confined to the Rocky Mountain uplift. They have been subdivided on lithological characters into upper and lower Banff limestones. These formations are each capped by shaly beds, from which have been obtained a few characteristic fossils. The formation is generally a bluish limestone, and forms the summits of Cascade and Rundle mountains, near Banff. A thickness of over 7,000 feet has been observed for the formation in the Bow valley.

Triassic

A series of red, sandy shales, capped by a thin bed of yellow dolomitic limestone, exposed along the western slopes of many of the ranges, occurs at Banff, and has been called the Upper Banff shale. Few fossils could be found at this locality, in these measures; but in their continuation north to the Brazeau, several shells resembling *Monotis* help the correlation with the Triassic rocks of the Peace and Pine rivers. South of the Kootenay pass these rocks are associated with a volcanic trap outflow.

Jurassic

Fernie shale

In the locality where this formation received its name near Fernie, B.C. it consists of a series of black and brownish shales, 1,060 feet in thickness, overlying 500 feet of sandy argillites. Eastward, through the Crowsnest pass, the series decreases in thickness, and at Blairmore, near the edge of the mountains, there is only 700 feet. On the Cascade river the section is 1,600 feet, and consists of black shales and grey sandstones, with an occasional limestone bed towards the base. In the Moose Mountain area an outlier of the Rockies the thickness is only 225 feet. The formation has been traced northward to the Athabaska river, and preserves its general black, shaly appearance. Few fossils have been obtained in these measures, but these are characteristic. From near Fernie, Dr. Whiteaves describes *Cardioceras Canadense* in the *Ottawa Naturalist*, Vol. XVII, p. 65.

From Minnewanka lake, Mr. McConnell collected:

Terebratula robusta; also obtained in 1872 by J. Richardson, from Skidegate inlet, Queen Charlotte islands: -

Ostrea Skidegatensis.

Exogyra sp.

Lima perobliqua.

Pteria (Oxytoma) *Cornuelliana*, d'Orbigny.

Trigonoarca tumida; also from Maud island, Queen Charlotte islands.

Trigonia Dawsoni; also from south side Alliford bay, Queen Charlotte islands.

Astarte Carlottensis, east side Alliford bay and Iltasyouco river, B.C.
Protocardia Hillana, also from Queen Charlotte islands.
Cyprina occidentalis, Lima island, Queen Charlotte islands.
Pleuronomya Carlottensis, also from Maud island.
Schlænbachia borealis, also from Rink rapids, Yukon river.
Schlænbachia gracilis.

The above list shows a remarkable similarity to the fauna of the "Lower Shales" of the Queen Charlotte Island series. Messrs. Staunton and Martin place this fauna well down in the Jurassic.[1]

On the Red Deer river, within the mountains, exposures are found containing great numbers of Belemnites, and one small Ammonite described by Dr. Whiteaves under the name *Peltoceras occidentale*. This is regarded as a purely Jurassic form.

On the headwaters of Sheep River north, a thin limestone band in the formation was found to contain many small reptilian bones and teeth.

Cretaceous -

Kootanie

The lower member of this series of deposits is found resting upon the Jurassic in the Rocky mountains. In Manitoba it has not been recognized, and is supposed to have formed but a very thin sheet to the east. It is recognized in the southern part of Dakota, and in Montana. In the Rocky mountains the base of the formation is a heavy bed of sandstone, which is succeeded by sandstones and shales containing many coal seams. The maximum deposition during this period was west of the axis of the Rocky mountains. In the Elk River escarpment the formation measures 5,300 feet. East of this, at Blairmore, it is reduced to 740 feet. North, near Banff, it has a thickness of 3,900 feet; and in Moose mountain, east of the main range, there are only 375 feet. Northward, on the Bighorn, the thickness is about 2,000 feet. It would seem that east of the mountains the formation was not of great importance, owing to thinning of the beds. The fossils of the formation so far described are plants - ferns, cycads, and conifers.

Dakota -

In the mountains, above the coal-bearing sandstone, a series of conglomerates and sandstones that have a newer flora. The measures are not distinctly coal-bearing, though a few thin seams are found. Fresh water conditions during this deposition prevailed in Dakota and Montana, and probably along the western margin; but northward, on the Athabaska river, the Tar sands representing a period contemporaneous with the Dakota of Manitoba, have a marine fauna.[2]

The thickness of the formation in Manitoba cannot be much over 200 feet. In the foothills a thickness of 150 feet seems to represent the formation; but westward, in the Elk River valley, a much greater thickness of coarser material is found.

Benton -

Dark grey, almost black, shale of marine origin. In Manitoba the deposit is about 175 feet in thickness. In the foothills it is over 700 feet; but this undoubtedly includes the overlying Niobrara. Very few forms

[1] Bull. Geol. Soc. Am., Vol. 16, p. 402.
[2] Ottawa Naturalist, Vol. XII., p. 37.

of animal life appear in these measures, but in Alberta they include such forms as *Inoceramus problematicus, Scaphites ventricosus, Prionocyclus Woolgari.*

Niobrara -

In Manitoba, the formation consists of grey calcareous shales, which are an upward continuation of the Benton beneath. The thickness varies from 130 to 200 feet, though it is apparently much thicker in places. The upper part is rich in calcite, and is used in making a common grade of cement in Manitoba. The presence of Foraminifera is a characteristic feature of the formation. The fossils include *Serpula semicoalita, Ostrea congesta, Anomia obliqua, Inoceramus problematicus, Belemnitella Manitobensis, Loricula Canadensis, Ptychodus parvulus, Lamna Manitobensis, Encholus Shumardi* and *Cladocyclus occidentalis.*

Eagle -

In the foothills the only exposure that can be correlated with the Eagle sandstone of Montana is a thin 50 ft. bed of light coloured sandstone.

Claggett -

The "lower dark shales" of Dawson in the Milk River region of southern Alberta—marine in origin, and holding fossils which are mainly the same as in the Pierre—have, in that locality, been given a thickness of 800 feet. In Manitoba—the lower part of the Pierre - the Millwood shales may represent this deposition. The fossils here found include a number of radiolaria and *Pteria linguiformis, Inoceramus tenuilineatus, I. sagensis, Lucina occidentalis, Entalis pauperula, Dentalium gracile, Baculites compressus, Scaphites nodosus, Hyglobites cretaceous,* and fragments of fishes.

Belly River

The Judith River formation of Montana is found to continue north into Alberta, and to constitute there the beds already called "Belly River." No exposures occur east of Saskatchewan; but if the divisional line between the two portions of the Pierre in Manitoba marks the horizon occupied by them, there may be found thin beds to the east of those known. The formation is represented in the north, on Peace river, by the Dunvegan beds. In Alberta it is described as consisting of two divisions: an upper pale series, and a lower yellow part. In the upper, brackish water mollusks are found, consisting mainly of fresh water deposits. The lower portion is distinctly yellowish in colour, and is mainly a brackish water formation.

The rocks are sandy clays with shales and sandstones, and the total thickness of the formation seems to be 900 feet. The thickness of the part exposed in Alberta may be not far short of 900 feet, though it evidently thins out eastward.

Coal seams occur in the upper or fresh water portion, and the fauna resembles very closely that of a Tertiary type in beds above. The most characteristic mollusk found is *Corbula perundata*, which is absent from the formation above. The collections from these beds include the following: *Ostrea glabra, Ostrea subtrigonalis, Mytilus subarcuatus, Anasanta propatoris, Unio primævus, Unio consuctus, Sphærium formosum, Corbula subtrigonalis, Corbula perundata Physa Copei, Viviparus Conradi,* with many vertebrate remains for which see No. 774, Contribution to Canadian Palæontology, Vol. III.

Bearpaw –

The Pierre-Foxhill of the writers of the geology of Saskatchewan and Alberta is without doubt that portion of the Pierre which is above the Belly River formation; but since it has been shown that the typical Pierre embraced beds below this shallow water and land deposit, new names have been suggested by Messrs. Stanton and Hatcher –Claggett for the lower shales, and Bearpaw for the upper. Few fossils have been obtained in Canada from the Claggett; but the Bearpaw, a similar grey clay shale, is found to be very rich in remains of animal life. A partial list only can be inserted here.

Fossils of the Bearpaw (Pierre):

Lingula nitida, Ostrea patina, Pteria linguiformis, Inoceramus altus, I. Nebrascensis, I. tenuilineatus, Modiola attenuata, Voldia scitula, Lucina occidentalis, Cyprina orata, Protocardia subquadrata, S. borealis, Mactra gracilis, Anisomyon centrale, Baculites compressus, Baculites grandis, Scaphites nodosus, Placenticeras placenta.

In Manitoba, the upper part of the Pierre is called Odanah, and may represent the same time interval as the Bearpaw.

Edmonton

The Laramie rocks of Southern Saskatchewan are, over a large part, divisible into two distinct divisions. The lower one consists of about 150 feet of feebly coherent, greyish, and pure white clays, sandy clays, and sands with occasional beds of carbonaceous shales and lignites.[1] This lower unnamed part bears the same relation to the marine clays of the upper Pierre that the Edmonton of Alberta does, and is here correlated with it.

In Alberta, the rocks of the southern part described as Laramie are divided into three divisions, and the lower part of the lowest member – the St. Mary River beds –is of about the same horizon as the Edmonton of northern Alberta. It is distinctly a series of light coloured clays and sands, and contains numerous coal seams. The deposits form a brackish water transition series between the marine clays of the upper Pierre or Bearpaw, and the Tertiary, or purely fresh water formation. The fossils consist of Dinosaurian remains, with land plants, and the following brackish-water forms: *Ostrea glabra, Unio Danæ, Corbicula occidentalis, Panopæa sigulatrix, P. carta.*

The thickness of the formation varies, but attains a maximum of 700 feet in central Alberta.

Tertiary

Paskapoo

This series consists of fresh water deposits, generally of yellowish sandstones and bluish grey and olive sandy shales. It embraces the upper part of the Laramie of southern Alberta and Saskatchewan, with a total thickness of about 5,700 feet. The remains of plants are numerous, and denote a flora of a temperate climate.

The fresh water fossils include: *Unio Danæ, Sphærium formosum, Limnæa tenuicostata, Physa Copei, Aeroloxus radiatulus, Thaumastus limnæiformis, Goniobasis tenuicarinata, Campeloma productus, Viviparus Leai, Valvata filosa, V. bicincta.*

[1]Annual Report, Vol. I, 1895, p. 67C

Miocene -

Isolated exposures of coarse grained material deposited on the eroded surface of the Laramie (in northern Alberta the Paskapoo series) have been found to contain a considerable number of mammalian bones. These beds are characterized by the great quantity of waterworn pebbles derived from the quartzites of the Rocky mountains.

STRUCTURAL AND HISTORICAL GEOLOGY.

The structure of the region can only be briefly outlined. The subsidence during Palæozoic times of parts of the central continental area is shown in the marine limestones outcropping in Manitoba and the Rocky mountains. Afterward the depressions in which the Mesozoic rocks were deposited first appeared in the longitude of the Rocky mountains, and Triassic and Jurassic deposits are there found. Early Cretaceous depositions occur in the same district following a shallowing of the sea, in which very little of the present continent was submerged. The unconformity between the Cretaceous and the Palæozoic floor, on which it was laid down, is shown in the fact that, varying time intervals are there recorded. Thus, in Manitoba, Dakota beds lie on upper Devonian, and in the Rainy River district possibly on Archæan. In Stearns county, Dakota, the floor is Archæan; but on the southwest border, Jurassic, and probably lower Cretaceous, are separated by a probable unconformity. On the Athabaska river, marine beds of Dakota age rest on Devonian; while in the Rocky mountains there seems no visible break in the section through Carboniferous, Triassic and Jurassic, to the lowest known horizon of the Cretaceous. The floor then, on which the Cretaceous was laid down, was probably a plane of erosion in which the formations occupy successive bands; the newer beds being those on the west.

The Cretaceous covering appears to have been deposited also in a somewhat irregular manner owing to crustal movements. The Jurassic and lower Cretaceous do not appear to have covered the w[illegible]ea, and indicate that the Jurassic sea invaded the area along a narrow depression, now elevated in the foothills and Rocky mountains. Land conditions prevailed throughout portions of the early Cretaceous, but the occasional submergence extended a short distance east of the mountains; and in the United States to the south, appears to have gone as far as the Black hills, and part of Montana. The greatest amount of detrital matter is to be found, and evidence also of an abundant flora, along the western portion of this early Cretaceous depression.

A more general subsidence brought the sea farther northeast during Benton times, and covered the sandy deposits of the Dakota by a series of dark marine shales. In the western sections there is evidence of a possible shallowing at the top of the Benton; but in the east the sea continued to the close of the Niobrara.

The deposits of the Montana group indicate marine conditions; but its inception shows shallow water along the western margin. In the east, deeper water prevailed throughout. A shallowing of the western

part occurred about the middle of this period, and land conditions are there apparent. Land plants appear—preserved in coal seams. This area was again invaded by the sea, and these sandy deposits were covered by marine shales. The close of the Cretaceous is marked by an emergence from the sea; but during the periods of oscillation between land and shallow water conditions—when the surface remained near sea level—an abundant flora appears along with brackish water forms of animal life. The coal-bearing beds of this phase of the retreat of the sea have been called the Edmonton formation in northern Alberta; the St. Mary River series in southern Alberta; and the lower part of the Laramie in Saskatchewan.

Toward the close of the Laramie period the transfer of the great mass of deposits that had proceeded through Cretaceous times, began to unsettle the equilibrium of the area from which they had been derived, and the crustal movements which ended in the forcing up of the Rocky mountains, then commenced.

This movement seems to have been caused by a great lateral force shoving the crust from the southwest, and anticlinal ridges no doubt appeared, but soon developed into fault lines along which the Palæozoic floor was pushed up from the west, to form the mountain ridges. The amount of this displacement decreases in the ranges toward the east, and in the foothills brings only the middle Cretaceous beds to the surface.

The erosion of the ridges thus formed supplied much of the material found in the Miocene beds. The conglomerates of the upper portions are apparently derived from the quartzites of the mountains.

ECONOMIC GEOLOGY.

General Statement.

The economic value of the rocks of the Cretaceous, exposed as they are over an enormous area, lies chiefly in their coal-bearing beds. Although mainly sea deposits there are three horizons which show land conditions and evidences of plant life, and in these beds coal seams have been found.

A marine invasion of the central part of the continent during Cretaceous time was preceded in the then existing low trough of the present Rocky Mountain area by an abundant flora, so that the early Cretaceous was coal-bearing.

These beds—known as the Kootanie series—were subsequently covered with a series of marine shales deposited by an invasion of the sea; but a shallowing of this sea over the western part also brought about land conditions again in later Cretaceous times, and vegetation spread eastward; which was in turn buried by shales in the last invasion by the sea.

This second flora is preserved in the beds of the Belly River formation, and in places forms important coal deposits.

At the close of Cretaceous times, when the continent finally emerged from this sea invasion, and while the land surface oscillated slightly at or near sea level, another mantle of vegetation covered the low ground.

Coal seams were then formed, and in the rocks which succeed these coal beds, impressions of leaves, stems, and petrified wood, show an increasingly changeable climate, and probably an increasing altitude.

The last deposits of the Cretaceous and the early ones of the Tertiary form the third coal horizon, and include the Edmonton and the lower Laramie.

The three coal horizons thus found are: -

Edmonton-Laramie formations.
Belly River formation.
Kootanie formation.

General Character of the Coals.

As is often found, the character of the coal varies with the age of the formation, and the amount of the covering beds. In this case the general law holds, but a far more important element has also influenced the alteration. The lateral disturbance and pressure in the formation of the Rocky mountains has made a great change in the character of the coal.

Edmonton-Laramie coals.- In the undisturbed regions the coals are lignites, but grade from those bordering on true coals in the west to poor lignites, having twenty per cent of moisture. In the disturbed area this formation contains coals that grade up from good lignites to true coals.

Belly River coals. In the undisturbed areas the coals grade from true coal to lignite, as in the series above, but are generally of better class. In the disturbed belt they border on coking coals.

Kootanie coals. -As these are in the lower measures, and have been subjected to greater load, they are, as would be expected, of higher grade, but as the exposures are all in the broken and faulted blocks of the mountain area, a much greater change has taken place than would be expected in undisturbed beds. The coals range from coking coals to anthracites. The anthracitic area is that of the Cascade basin – the greatest alteration being found near Banff.

The Flora of the Cretaceous Coal Measures.

The flora of the Cretaceous has formed the subject of many papers, mainly from the pen of Sir J. W. Dawson, supplemented in later studies by Professor D. P. Penhallow. The main economic value of these rocks is, without doubt, their coal contents; and although the whole land flora is not supposed to have entered into the composition of the coal beds, it is proposed to briefly summarize the general character of this flora.

The earliest Cretaceous plants appear in the Kootanie series, and although—according to Sir J. W. Dawson—there seems to have been a few species of a Jurassic aspect, the majority are to be correlated with those of Cretaceous beds elsewhere, and, therefore, the facies of the flora of the formation as a whole show a decidedly early Cretaceous aspect.

Plants of the Kootanie Formation.

From the type locality – Elk River valley: –

Dicksonia sp.; *Asplenium martinianum*, Dawson; *A. Dicksonianum*, Heer; *A. distans*, Heer; *Dioonites borealis*, Dawson; *Podozamites lanceolatus*, Lindley; *Zamites Montana*, Dawson; *Z. acutipennis*, Heer; *Anomozamites acutiloba*, Heer; *Sphenozamites* sp.; *Antholites horridus*, Dawson; *Salisburia* (Ginkgo) *Sibirica*, Heer; *S. lepida*, Heer; *S. nana*, Dawson; *Baiera longifolia*, Heer; *Pinus Saskatchewanensis*, Dawson; *Sequoia Smittiana*, Heer; *Glyptostrobus Groenlandicus*, Heer; *Taxodium cancatum*, Newberry.

From Canmore and Anthracite:

Three of the above species, namely, *Asplenium martinianum*, *Zamites Montana*, and *Dioonites borealis*. The following are additional:

Equisetum lyellii, Mantell; *Angiopteridium Canmorense*, Dawson; *Pecopteris browniana*, Dunker; *Cladophlebis falcata*, Fontaine; *Aspidium fredericksburgense*, Fontaine; *Leptostrobus longifolius*, Fontaine; *Pinus nordenskioldii*, Heer; *P. anthraciticus*, Dawson; *Sphenolepidum pachyphyllum*, Fontaine.

The series from Moose mountain contains the following:

Dryopteris fredericksburgensis (Font.), Knowlt.; *Cycadites longifolius* Font.), Knowlton; *Sagenopteris mantelli* (Dunk), Schenk; *Athrotaxopsis tenuicaulis*, Font.; *Sagenopteris*, n. sp., *Thyrsopteris meckiana*, Font.; *Sequoia heterophylla*, Vel.; *Sequoia smittiana*, Heer; *Sagenopteris elliptica*, Font.; *Baieropsis pluripartita*, Font.; *Podozamites longifolius*, Emmons.; *Podozamites lanceolatus* (I and II), Schimp; *Thyrsopteris insignis*, Font.; *Thyrsopteris pecopteroides*, Font.; *Cladophlebis falcata*, Font.; *Zamites arcticus*, Gopp.; *Ginkgo huttoni magnifolia*, Font.; *Cladophlebis constricta*, Font.; *Cladophlebis distans*, Font. (?); *Nilsonia*, n. sp.

In the foothills traces of a flora intermediate between the Kootanie and Dakota are found in the Mill Creek beds and in the Moose Mountain section, which is there assigned to the Dakota.

Dakota and transition beds.

The Mill Creek flora embraces the following forms:

Cleichenia gracilis, Heer; *G. kurriana*, Dawson; *Dicksonia munda*, Dawson; *Asplenum albertum*, Dawson; *Williamsonia recentior*, Dawson; *Platanus heeri*, Lesq.; *P. affinis*, Lesq.; *Liquidambar integrifolium*, Lesq.; *Alnites insignis*, Dawson; *Macclintockia cretacea*, Heer; *Proteoides daphnogenioides*, Heer; *Cinnamomum canadense*, Dawson; *Laurophyllum debile*, Dawson; *Laurus crassinervis*, Dawson; *Aralia rotundata*, Dawson; *Aralia westonii*, Dawson; *Hedera ovalis*, Lesq.; *Magnolia magnifica*, Dawson; *Paliurus montanus*, Dawson; *Paliurus ovalis*, Dawson; *Juglandites cretacea*, Dawson.

From the Moose Mountain section of the Dakota beds the following forms have been determined: –

Carpolithus ternatus, Font.; Fruits, probably of Ginkgo; *Sphenolepidium sternbergianum densiflorum*, Heer; *Ginkgo lepida*, Heer; *Ginkgo sibirica*, Heer; *Ginkgo*, sp., male inflorescence.; *Athrotaxopsis tenuicaulis*, Font.; *Nilsonia californica*, Font.; *Ginkgo huttoni*, Heer; *Thyrsopteris brevipennris*, Font.

Judith River formation, Belly River of Dawson

From banks of the Belly river:

Pistia corrugata, Lesq.; *Lemna scutata*, D.; *Brasenia antiqua*, Dawson; *Populus latidentata*, Dawson; *Acer Saskatchuense*, Dawson; *Sequoia Reichenbachii*, Dawson

From Pine and Peace rivers:

Asplenium niobrara, D.; *Cycadites unjiqa*, Dawson: *Carpolithes horridus*, Dawson; *Glyptostroba gracellimus*, Lesq.; *Sequoia reichenbachii*, Heer; *Torreia dicksonoides*, Dawson; *Ficus maxima*, Dawson; *Fagus proto-nucifera*, Dn.; *Laurophyllum debile*, Dn.; *Protoides longus*, Heer: *Betula* sp.; *Populites cyclophylla*, Heer; *Diospyros nitida*, Dawson; *Magnolia tenuifolia*, Lesq.; *M. magnifica*, Dawson; *Menispermites reniformis*, Dn.; *Protophyllum leconteanum*, Lesq.; *P. boreale*, Dn.; *P. rugosum*, Lesq.

From Moose mountain:

Populus elliptica, Newb.; *Betulites*, sp.; *Dioonites*, sp.; *Asplenium niobrara*, Dn.; *Athrotaxopsis tenuicaulis*, Font.; *Asplenium dicksonianum*, Heer; *Thyrsopteris pecopteroides*, Font.; *Protophyllum haydenii*, Lesq.; *Cissites*, sp.; *Ginkgo baynesiana*, Dn.: *Ginkgo sibirica*, Heer; *Paliurus cretaceus*, Lesq.; *Paliurus ovalis*, Dn.: *Salix*, sp.; *Quercus rhamnoides*, Lesq.; *Juglans crassipes* (?), Heer; *Angiopteridium strictinervis* (?), *Sphenopteris johnstrupi*, Heer; *Sequoia smittiana*, Heer; *Sequoia cuneata*, Newb.; *Sequoia reichenbachii*, Heer; *Sequoia ambigua*, Heer; *Abites grandifolia*, Newb.

Many of these forms are of a Dakota type, but the formation seems to be situated above the horizon of the Colorado group.

Edmonton and Lower Laramie of Saskatchewan.

Plants collected: -

Abietites tyrrellii, Dawson; *Sequoia reichenbachii*, Heer; *Platanus Newberryana*, Heer; *Taxodium occidentale*, Newberry; *Taxites Olriki*, Heer; *Lemna* (spirodella) *scutata*, Dawson; *Platanus nobilis*, Newberry; *Castanea*, sp.; *Sapindus affinis*, Newberry; *Æsculus antiqua*, Dawson; *Trapa borealis*, Heer; *T. microphylla*, Lesquereux.

Paskapoo and Laramie.

The flora of this formation has been preserved in the sandstones as leaves and fossilized woods; coal seams occur, but not in as great number as in the Edmonton. As the plants are scattered through the formation a greater variety have been found, many of which possibly may be found in the lower part and in the Edmonton. The list is a long one, but has not been compiled hitherto into one. The determinations are by Sir J. W. Dawson and D. P. Penhallow.

List of Tertiary plants: -

Onoclea sensibilis, Newberry; *Sphenopteris gayottii*, Lesq.; *S. blomstrandi*, Heer; *Lastrea fisheri*, Heer; *Davallia* (Stenoloma) *tenuifolia*, Linn; *Equisetum arcticum*, Heer; *Thuga interrupta*, Newberry; *Sequoia couttsii*, Heer; *S. nordenskioldii*, Heer; *S. langsdorfii*, Heer; *Glyptostrobus europeus*,

Brngt.; *Podocarpites tyrrellii*, Dawson, *Taxodium occidentale*, Newberry; *T. distichum miocenum*, Heer; *Taxites olriki*, Heer; *Lemna* (spirodella) *scutata*, Dawson; *Phragmites* sp.; *Scirpus* sp.; *Platanus nobilis*, Newberry; *P. raynoldsii*, Newberry; *Castanea* sp.; *Quercus* sp.; *Q. ellisiana*, Lesq.; *Glyptostrobus europeus*, Heer; *Typha* sp.; *Meyachemophyllum grandifolium*, Penhallow; *Clintonia oblongifolia*, Penhallow; *Populus angeri*, Lesq.; *P. obtata*, Dawson; *P. daphnogenoides*, Ward; *P. richardsoni*, Heer; *P. acerifolia*, Newberry; *P. artica*, Heer; *P. genetrix*, Newberry; *P. nervosa*, Newberry; *Salix varana*, Heer; *S. laramiana*, Dawson; *Sassafras schimii*, Dawson; *Corylus americana fossilis*, Newberry; *C. macquarrii*, Forbes; *Ulmites grandifolia*, Newberry; *Carya antiquorum*, Newberry; *Juglans leconteana*, Lesq.; *J. rugosum*, Lesq.; *J. Schimperi*, Lesq.; *J. rhamnoides*, Lesq.; *J. occidentalis*, Newberry; *J. laurifolia*, Knowlton; *J. acuminata* A Braun; *Viburnum oratum*, Penhallow, *V. saskatchuense*, Dawson; *V. asperum*, Newberry; *V. Calgarianum*, Dawson; *V. oxycoccoides*, Dawson; *V. lancolatum*, Newberry; *Sapindus affinis*, Newberry; *Æsculus antiqua*, Dawson; *Symphoracarpophyllum albertum*, Dawson; *Paliurus colombii*, Heer; *Cornus rhamnefolia*, Web.; *Cercis parrifolia*, Lesq.; *Phyllites crassus*, Newberry; *P. carneosus*, Newberry; *P. caparinoides*, Newberry; *Nelumbium saskatchuense*, Dawson; *Trapa borealis*, Heer; *Catalpa crassifolia*, Newberry.

General Description of the Formations and Areas.

A general résumé of the extent and coal content of the measures of the three coal horizons previously enumerated is here discussed, with references to reports in which full details may be found. The lowest horizon is discussed first.

Kootanie Formation.

This being at the base of the Cretaceous, and near the limestone beds which represent the Carboniferous and Devonian, is exposed only in and near the Rocky mountains. The faults and uplifts which bring up the limestone beds have also elevated these coal measures, but a great part has been denuded. As the general system of mountain building for the outer ranges of the mountains is a series of fault blocks dipping mostly to the west, these blocks have often remnants on their rear slopes of the overlying Kootanie, and the coal measures are usually to be found against the next succeeding fault block. Within the mountains the coal fields are generally found in long narrow strips between the ranges. The thickness of the formation which is coal-bearing reaches a maximum in the Elk River valley of 4,700 feet, in which there are twenty-two workable seams. The minimum is to the east, and in the foothills has been found to be not much over 200 feet, with only three good coal seams. In addition to the Alberta areas the Kootanie is also found on the western slope within the Province of British Columbia. This is the Elk River or Crowsnest field—perhaps the most important in Canada.

The Alberta areas are not individually as extensive, but are distributed from near the International Boundary to near the Athabaska river.

Coal Creek Coal Mine, Fernie, B.C. 1909. Page 6, Vol. I.

The base of the measures is generally marked by a heavy bed of sandstone, above which is a succession of sandstones and shales rich in coal seams, varying in thickness in the different fields. The top of the formation where the coal seams are found is marked by course conglomerate in the southern areas, but finer toward the north.

British Columbia Areas.[1]

The areas in British Columbia, on the Elk river, are divided into two portions. The southern one—for which Fernie is the largest shipping point—has a length north and south of about thirty miles, and a maximum width of twelve or thirteen miles, with an estimated area of 230 square miles. The coal-bearing rocks have in several sections been found to have a thickness as great as 4,700 feet. In this area there are twenty-two workable seams, with a total of 216 feet of coal, 100 feet of which are estimated as workable. This would give a total workable coal content for the district of 22,600,000,000 tons.

The coal is a high grade bituminous, occasionally running into anthracitic. The majority of the seams are used for the manufacture of coke, but steam coal is a product as well. The collieries are situated at Coal Creek, near Fernie, Michel, Morrissey and Hosmer. The northern part of this coal field extends from about twenty-four miles north of Michel creek, to the height of land at the Kananaskis river, a distance of nearly forty miles. The width does not exceed seven miles as a maximum, and toward the north diminishes to a vanishing point at the source of the Kananaskis.

The area has been computed to be about 140 square miles, and the number of workable coal seams is large. In one place, Aldridge creek, for example, it is estimated at sixteen square miles, with a total thickness of 163 feet of coal. If 100 feet be extracted, then, on the assumption that the whole area of 140 miles is of equal value, the total coal may be estimated at, say, 100,000,000 tons per square mile, or a total of 14,000,000,000 tons.

Alberta Areas.

The areas in Alberta crossed by the Crows Nest branch of the Canadian Pacific railway within the mountains, including those mined at Coleman, Frank, Lille, Belleview and several other collieries, are discussed under the two following headings:—

Coleman Area.[2]

The Coleman area is a narrow belt, or fault block, with the measures dipping to the west. It can be considered to have a breadth of one and a half miles, and its longitudinal extension, although not definitely known,

[1] Sum. Rep., G. S. Dept., 1900, pp. 85-95.
Sum. Rep., G. S. Dept., 1901, pp. 75-79.
Sum. Rep., G. S. Dept., 1905, pp. 59-60.
[2] Sum. Rep., G. S. Dept., 1902, pp. 167-179.

is approximately thirty miles. The measures are known to have seams aggregating over 100 feet of coal, and if 50 feet be assumed for workable thickness, this represents a total of 2,000,000,000 tons.

Blairmore-Frank Area.[1]

The Blairmore-Frank area is irregular in outline, and probably twenty-five miles long by two to three miles wide. The coal content is probably over 50 feet of workable coal; though possibly not all of it can be reached, owing to the many faults and flexures in the formation. An estimate of fifty square miles, from which say 30 feet might possibly be won, would give for this area approximately 1,500,000,000 tons. In general character, the coal in the Coleman, Blairmore, and Frank areas is a bituminous coking, and steam coal, with from 10 per cent to 14 per cent ash.

Livingstone Area.[2]

An important area not yet thoroughly prospected is crossed by Livingstone, Highwood, and Sheep Creek upper waters. On the south branch of Sheep creek important seams have been discovered, and it may be assumed that, within an area of sixty miles in length, workable seams underlie, averaging more than a mile in width. The quantity of coal available can only be approximately estimated; but if 30 feet only be assumed as a probable thickness, the total available might amount to 1,500,000,000 tons.

Moose Mountain Area.[3]

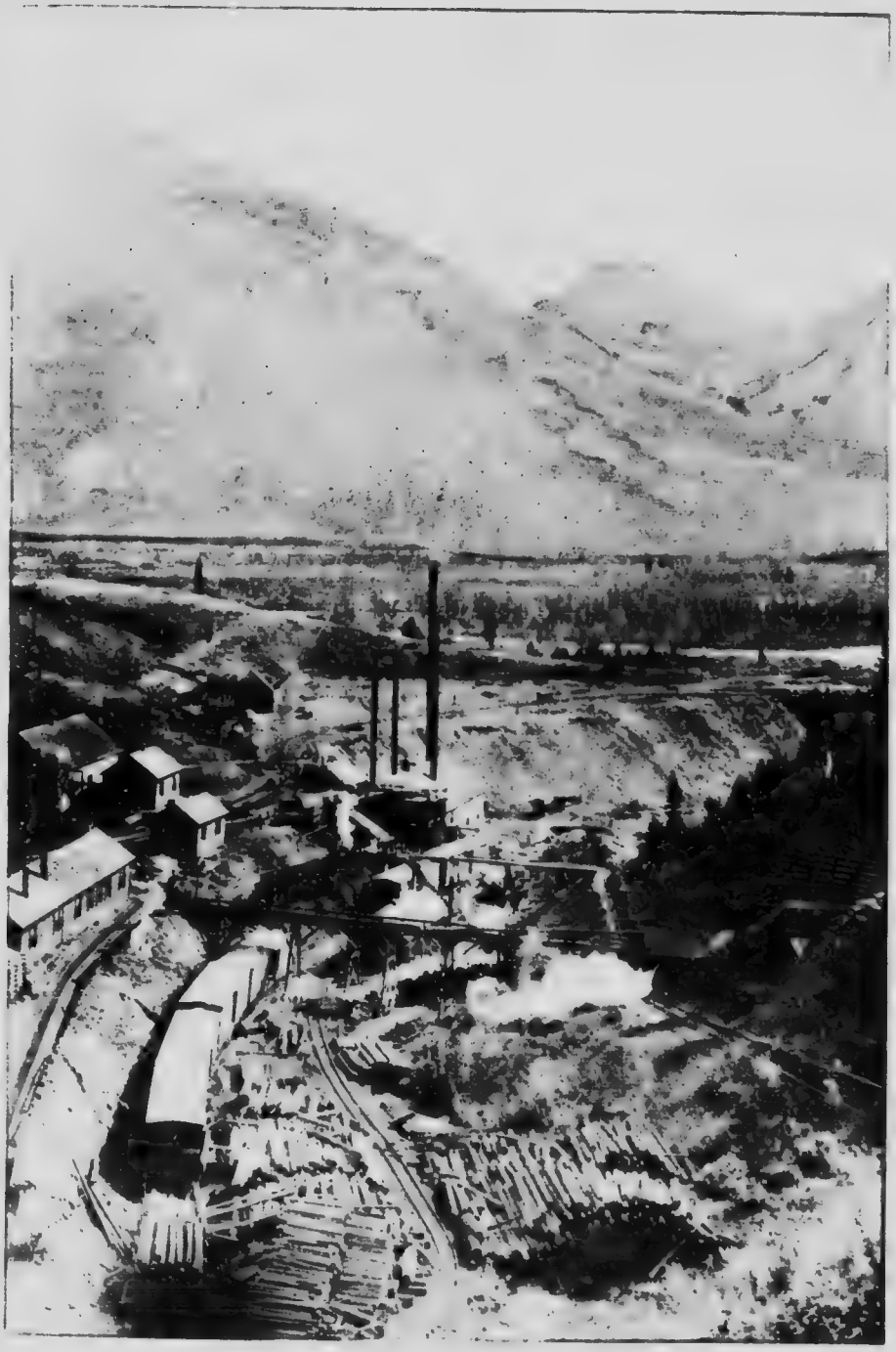
The Moose Mountain area south of Morley forms an oval ring, embracing an exposure of limestone forming Moose mountain. The beds are much thinner than within the ranges, and show an evident tendency toward a loss of coal also. Two seams of coal have been opened on the east side of the mountain, of 7 and 8 feet in thickness, respectively. In each of the seams the character continues to be of good grade steam coal, as the appended analyses will show. The formation is cut by several streams, the valleys of which give access to the seams, and a great deal of this coal will be mined. Further prospecting in this area is reported, and a thick seam of 20 feet added to the above coal content.

The area is, roughly speaking, twenty-five miles long; and as it encircles the mountain, an average width for this length may be taken as one mile of available ground. This area, with 15 feet of coal, should produce 250,000,000 tons.

Cascade Area.[4]

The Cascade area extends from south of Kananaskis river to within about twelve miles of the Saskatchewan. The coal measures are not

[1]Sum. Rep., G. S. Dept., 1902, pp. 167-179.
[2]Sum. Rep., C. S. Dept., 1903, pp. 83-87.
[3]Sum. Rep., G. S. Dept., 1905, p. 67. Moose Mountain district, by D. D. Cairnes, No. 968.
[4]Part B, Annual Report, Vol. I. (1885). Part D, Vol. II. (1886). Sum. Rep., 1903, p. 88. Sum. Rep., 1904, p. 107. Cascade Coal Basin, No. 949.



CANMORE COAL MINE, ALBERTA

see 3a -p. 31.

continuous throughout this whole extent, but are interrupted by denudation and folds at the headwaters of the Cascade and Panther rivers. The beds to the south of Kananaskis river are divided in the centre by an anticline into two arms that narrow to two folds, which gradually pass upward, and are eroded away. North of this stream to the Bow valley there is a thick block of measures dipping to the southwest, with a decided trough in the upper members of the series. At the northern end there are ten coal seams, each over 4 feet in thickness: the thickest of the upper ones reaching 15 feet. The total of these seams amounts to 68 feet.

From Wind mountain northward the masses are planed off to the slope of the sides of the Bow valley, and at Canmore mining is all below the level of the entrances, and the beds are found very much folded. North of the [illegible] the coal in a large block east of Cascade mountain is being mined from the Cascade river at Bankhead.

No great area of coal land can be looked for between the Cascade and Panther rivers; though there are some beds not eroded from the hills at the centre of the valley. North of the latter stream several seams have been found. North of Red Deer river the section shows fifteen seams, between 4'-6", and 11 feet in thickness, giving a total of 94 feet.

The coal found in the various parts of the area varies in composition from anthracite, to bituminous.

In the portion on the Cascade river and south to the Kananaskis, the lower seams may be said to be anthracite, or anthracitic; while in some places, the upper ones approach bituminous. In the northern part of the trough, north of the Red Deer, bituminous coals are found. Any estimate of the total amount of the anthracite would be entirely tentative, as the coal varies in hardness; but in an area forty miles long, and half a mile wide, the lower seams should be nearly all anthracite; and if we allow only 24 feet as the available part of these seams, we have a total of 400,000,000 tons of anthracite. The softer grades over the same area should amount to as much, and, allowing a working thickness of 50 feet in the area north of the Red Deer—ten square miles—and a similar amount for the Wind Mountain area, there should be a total of 1,200,000,000 tons.

East of this Cascade basin there are only two areas that appear to contain coal of economic importance.

Palliser Area.[1]

This area is crossed by Panther river, which almost divides it into two parts. The total coal area available is not over six square miles.

The coal seams are not many in number, and a 5 foot seam might be mined over a limited portion, so that a total of 20,000,000 tons may be estimated as the total possibilities of the area.

Costigan Area.[2]

This area lies to the east of the Palliser, and is a better block of coal

[1]Cascade Coal Basin, No. 969, p. 34.
[2]Cascade Coal Basin, No. 969, p. 35, and Sum. Rep., 1907, pp. 38-40. Sum. Rep., 1904 pp. 116-121.

rocks. The seams are not numerous, however, and although four or five are known on the western edge of the basin, there appear to be only two workable seams with about 8 feet of coal outcropping at the east. The area is triangular, with the widest part along Panther river, extending north to the Red Deer river. The possible area to be mined is perhaps less than twelve square miles, and the total coal on this assumption is about 60,000,000 tons.

Sheep Creek Areas.

Northeast of the extreme range of the Cascade coal basin, two areas are known to occur within the mountains; but as they have been very slightly prospected, no estimate of their extent has been made, other than their delineation on the map.

Bighorn Basin.[1]

From the Saskatchewan north, an outer range of mountains reaches nearly to the Brazeau river. Behind this the coal measures are exposed on several streams, and are found to contain about 60 feet of workable coal. The character is bituminous, and probably coking. The area is not well defined, but is known to be thirty miles long, and workable in some parts for a width of two miles. If an attempt at an estimate of the total tonnage is made on the basis of this area, it might be safe to assume thirty square miles, with a thickness of 50 feet of coal, which would give 1,400,000,000 tons.

The best section of the measures is obtained on the south branch of the Brazeau river. Nine seams varying from 14′-5″ to 3′-11″ are found, with a total thickness of 66′-4″ of workable coal.

Other coal areas north and east of this, near the mountains, are reported, but it is in a country not fully mapped. If it can be assumed that the same measures are again exposed, the estimate of the available coal can be considerably added to. Between the Brazeau and the Saskatchewan a second outer range of limestone hills can be seen, and this would indicate other coal areas, provided the measures do not thin out, as they do to such an alarming extent from the Cascade basin eastward through the Costigan, or from the south end of the Cascade eastward in the Moose mountains.

Belly River Coal Formation.[2]

The second coal horizon lies above the Kootanie, and is separated from it by dark marine shales, which represent a period of depression in which this part of the continent was below sea level. The rise which followed was arrested when the surface of this deposit reached sea level, and vegetation again spread over the plain. The remains of this vegeta-

[1] Sum. Rep., G. S. Dept., 1906, pp. 72-73.
Sum. Rep., G. S. Dept., 1907, p. 33.
[2] Report on the Region in the Vicinity of the Bow and Belly rivers. G. M. Dawson, Report of Progress, 1882-4. Part C.

No. 3 Pit, Lethbridge, 1898. Photo., G. M. Dawson.

tion, compressed to coal, form an important field; for although the seams are not thick, the quality in the western portion of the exposed part is above the general average of lignite, and approaches true coal. In Saskatchewan it has so far been found to contain very thin seams of inferior coal in the northern part of the area, and possibly a 4 ft. seam in the southern border.

The general distribution of the rocks of this formation, as exposed at the surface, is shown on the map (No. 1,010). The shape of the area there shown, is roughly that of a duck's head and neck, and over the part comprising the head, few exposures of coal are noted; but there are chances that settlers may find in their wells indications of coal. This portion owes its exposure to a slight anticline in the beds which brings them to the surface along a line that follows the direction of the roll. The other portion, the neck, is the great depression, too wide to be called a valley, into which the waters of the Belly, Bow, and Red Deer rivers, drain. The formation westward disappears beneath the trough which runs through McLeod northward past Calgary, but reappears in several narrow bands in the foothills. At the northwest corner of the map, in the Peace River country, two areas in which coal is found are regarded as of the same age as the Belly River formation.

The principal exposures of coal in this formation are on the Belly river near Lethbridge. The coal is of a better grade than in the beds above it in the same vicinity.

South of Lethbridge the exposures include a few on the Milk River ridge, and one on St. Mary river about six miles above its mouth, with a thickness of 3′-8″. At Lethbridge the main seam is 5′-6″, and is mined at several localities nearby. Other seams are noted below the mouth of Little Bow river—one of 3′-3″; and, ten miles above Medicine Hat, a 4 ft. seam is exposed in the river bank. At Stair two seams, 4 feet and 5′-3″, were mined for a time. The thicker one reappears below the bend, and has been traced as far as twenty-five miles below Medicine Hat.

Small seams have been found as far as the mouth of Red Deer river. On this stream three seams are known below the mouth of Bull Pound creek, having thicknesses of 1′-3″, 1′-6″, and 3′-6″, which are evidently at about the same position in the series as the Lethbridge seams. On Bow river the Lethbridge seam is represented by a 4′-6″ seam, in tp. 17, R. 17, west of the 4th meridian, and, according to Dawson's map, should pass the Canadian Pacific railway near Bantry station.

On the eastern slope of the depression the Lethbridge seams should be represented by the coal found around the western base of the Cypress hills; the whole formation underlying the rocks forming that elevation. Near Irvine station a 4 ft. seam has been found, which has unfortunately not been analysed; but it is probably lignite.

The continuation of the beds eastward under the rocks of the plains can only be conjectured; but it is thought that they may thin out considerably and lose their coal-bearing character. Such occurrences as the drift coal below Prince Albert, and coal in the drift near Souris, Manitoba, are possibly evidences of this continuation.

In the Foothills.[1]

In the strip which runs through the foothills large portions are not prospected, but for one area at least we have more details. This comprises the foothills south of the main line of the Canadian Pacific railway, as far as Highwood river. On the Stoney reserve, south of Morley station, there is a 6 ft. seam in this formation. Several exposures on Jumpingpound and Elbow rivers have workable seams. The old Sheep Creek coal mine, south branch Sheep creek, is in this formation. Seams are reported south of this on Highwood river. Near Kananaskis station, the Rocky Mountain outer range overrides these beds, but it is not known whether or not they contain coal. Seams of lignitic coal in the mountains probably belong to this formation, since they appear to be higher beds than the coal-bearing ones just within the mountains farther down the stream, and identified as Kootanie.

Peace River.[2]

Two areas of these rocks are known in the Peace River country: one in Alberta reaching from Smoky river to the valley of Peace river, and extending northwesterly up that stream. Thin seams only are known. An analysis of coal from one of these on Smoky river is given.

Nearer the mountains, in the area belonging to British Columbia, better exposures have been found; and near the canyon of the Peace river, seams as thick as 9 feet are reported, though most of those from which analyses were obtainable, are of scarcely workable dimensions.

Area.

The area over which the Belly River formation is exposed is not far short of 25,000 square miles. If a workable seam of 4 feet were found to occur under this area, an enormous amount of coal would eventually be procured from the earth. This estimate would probably be excessive. Take as productive a total of this 5,000 square miles, with 4 feet of coal: the figures for tonnage would approximate to 13,000,000,000 tons.

EDMONTON-LARAMIE COAL FORMATIONS.[3]

In Saskatchewan, the Laramie formation occupies the summit of some of the plateaus, and portions of elevations such as the Cypress hills. It is quite evident that, from a great portion of the plains these rocks have been worn away, and what remains is merely the lower portion of the formation which is generally coal-bearing.

In Alberta the coal-bearing portion is called Edmonton formation, and forms there a trough filled along the centre by heavy sandstone

[1] Moose Mountain district. By D. D. Cairnes, No. 968.

[2] Report of Progress, 1875-6, pp. 6, 53. Report of Progress, 1879-80, pp 117, 119, 134-136 B. Report of Progress, 1882-1884, pp. 25-39 M.

[3] Report on Northern Alberta, Annual Report, 1886, Vol. II., Part E, and Report of Progress, 1873-4, pp. 17-65.

deposits of Tertiary age—the Paskapoo series. This trough widens towards the north, and also flattens, exposing a larger area of coal rocks than in the southern part. The productive area, therefore, forms a band surrounding the central sandstone portion, and dipping under it. On the eastern side the re-appearance from below is often accompanied by more or less disturbance, such as folds or waves, and faults. In this portion the effect of pressure has consolidated the coal to a greater extent, hence its character is improved.

The general description of the coal horizons of the Edmonton formation is summarized in Mr. J. B. Tyrrell's report on Northern Alberta, and is concise enough to be inserted in this sketch. On page 148 E of Vol. II, Annual Report of the Geological Survey of Canada, 1886, he says:

"Of lignite coals, the only seam of any considerable thickness at present known in the Paskapoo series (just above this coal formation) outcrops on the North Saskatchewan, twelve miles above the mouth of Yapeoo or Buck creek, in township 49, range 7, west of the 5th principal meridian. The outcrop of the seam is very much obscured by land slides, but in one place a thickness of 15 feet of lignitic coal was measured, and the bottom of the seam was not seen. In another place, five miles distant, this seam was seen to have a thickness of 8 feet. Taking, therefore, 11′ 6″ as the mean thickness of this seam throughout the five miles down the river, and assuming that it extends for at least a mile over either side of the river valley, this area would be underlaid by 140,000,000 tons of lignitic coal. This appears to be the same coal horizon that is represented by a thin seam both on the upper part and near the mouth of Paskapoo or Blindman river, and at the trail crossing on Rosebud creek.

"At the top of the Edmonton series, between 400 and 500 feet below the last mentioned seam, there is a very persistent coal horizon that is seen cropping out on the North Saskatchewan with a thickness of 25 feet, on the Red Deer with a thickness of 10 feet, on Devils Pine creek with a thickness of 4′–6″, on Threehills creek with a thickness of over 2 feet, and on Knechills creek with a thickness of 4 feet. It is impossible, at present, to compute the enormous amount of lignite, but the following figures may be given as the quantity that may be relied on with considerable certainty as occurring in the immediate vicinity of some of the above outcrops.

"On the North Saskatchewan the seam was seen to extend in a straight line for three miles, retaining its thickness of 25 feet; and for several miles farther, large outcrops were seen that could not easily be measured. It was also, in one place, seen to extend a mile back from the river. If we take then a length of three miles of this seam, a width of a mile on each side of the valley, and a thickness of 20 feet, in order to allow for any local constrictions, this small area would be found to contain over 150,000,000 tons. On the Red Deer river the seam contains 12,500,000 tons per square mile; on Devils Pine creek, 5,500,000 tons per square mile; on Knechills creek, 5,000,000 tons per square mile, and in the valley of this latter stream the seam was traced for from two to three miles down the creek. The line of outcrop of this seam

has, therefore, been traced more or less continuously for 180 miles, and as will be seen by referring to the preceding pages, the lignite coals at the outcrops were of good quality.

"Throughout the Edmonton series there are various other coal seams of greater or less extent, many of which will be opened as the country becomes more fully developed; but the one that appears to be most persistent is found at a height of about 160 feet above the bottom of the series. At the mouth of Rosebud creek this seam was found to have a thickness of 6'-10", while on Battle river and Meeting creek, it has a thickness of 4 feet, representing 5,000,000 tons per square mile. This is essentially the same coal horizon that is again seen at Edmonton, on the North Saskatchewan, though it is hardly likely that the same seam is continuous throughout."

Alberta: Localities of Exposures of Edmonton Coal.

Few exposures of coal are known south of the Little Bow river. This district has not, however, been thoroughly examined, and the proximity of the Lethbridge mines—which produce a better grade than most of the coals of this formation—has discouraged prospecting.

On the Bow river, near Crowfoot crossing, two seams of 3 feet, and 4-6" respectively, seem to be worth working. A small mine has been opened on Crowfoot creek, by shaft, to a 9 ft. seam.

On Red Deer river, seams of 5 feet and 6 feet, are reported near the mouth of Rosebud river; and on a branch—Knechills creek—a 4 ft. seam is exposed.

Near the outlet from Buffalo lake two seams outcrop, the lower one occupying 18 feet of beds. The lower part (3 feet) is good lignite; in the upper portion about 3 feet are also of fair quality. The upper seam outcrops above Tail creek, and it has a great thickness of shaly material interstratified with the coal; but there is at the top a clear bench of 5 feet of coal.

On Battle river a few of the seams of this horizon are exposed. At the [illegible]outh of Meeting creek a seam of 4'-6" appears on the west bank, an[illegible]ners probably occur above this.

[illegible]der the town of Edmonton a couple of seams are being worked. T[illegible]se, though not above 6 feet in thickness, are of a good class for domestic use. The same seams underlie a large area in this vicinity, and are worked at many p[illegible]ints. The principal mines are here, and at Morinville, north of Edmonton.

Skirting the edge of the sandstones which occupy the central part of the coal areas, it will be noticed on the map that, there is in the northern portion a persistent coal band. On the Red Deer river it appears to have only 5 feet of good coal in its upper part; but where this upper seam crosses the Saskatchewan above Edmonton it is a very valuable deposit, which is generally spoken of as the Big seam. This has 25 feet of coal, divided, 10 feet from the top, by 12 inches of shale. The continuation of this seam crosses the Pembina river, near the location adopted by the Grand Trunk Pacific, and will here certainly be mined. There are several heavy coal seams exposed, showing thicknesses of 26

THE BIG COAL SEAM, SASKATCHEWAN RIVER, NEAR GRAND ROCHE ESCARPMENT, 1880. Photo: G.M. Dawson

feet, 10 feet, 13 feet, and a lower one of 6 feet. Analyses of these are given in the table

Exploration of the northern continuation of the field has been limited; the outlining of the area being about all that has been attempted. Heavy beds of coal are found on the Athabaska above McLeod river, that may represent the horizon of the big seam of the Saskatchewan. In the narrow band that intervenes between the sandstone of the centre of the trough and the disturbed area of the foothills, these coal beds undoubtedly reappear, and valuable coal beds have been found in them. There are probable repetitions of these beds all through the foothills as the latter, especially to the north, are formed of rocks which have been faulted along lines parallel to the mountain ranges, so that the beds are repeated many times. In the country along the route to the Yellowhead pass, coal-bearing rocks of this formation are found close to the mountains.

The geological structure of this area is not well known, and, therefore, there is no attempt on the map to indicate the seams or coal areas. On the Pembina, Brazeau, and Saskatchewan, heavy lignite seams are known to outcrop in the band as marked. An analysis of the coal at Rocky Mountain House, near the confluence of the Clearwater and Saskatchewan, shows it to be of better grade than that farther down the river.

On Red Deer river a 10 ft. seam, in range VII, west of the 5th meridian, is of this horizon, and west of Cochrane, at the Old Bow River mine, two seams which are reported as being 5'-6", and 7'-7" thick, respectively, are certainly of better grade than anything east of this point.

This band crosses Sheep creek near the forks of the north and south branches, and lignites may there be looked for. On Highwood river a small seam is noted in range II, which is probably in this horizon.

Behind the Porcupine hills the beds have not been traced, but nearing the Crowsnest river they are found again. A 7 ft. seam near Cowley is probably in the Edmonton formation, as well as others on Pincher creek.

It is impossible to make any just estimate of the total amount of coal in this formation, as the area over which it is spread is so extensive, and the thickness of the coal seams so uncertain, that, an over-estimate would probably be the result.

South of Bow river the eastern portion does not seem to have much coal exposed. If we assume that from the Bow river north, to Edmonton, the formation will average a workable 6 ft. seam, this alone, with its area of 10,800 square miles, would give a total of 60,000,000,000 tons. Part of this area would not be productive; but on the other hand the heaviest seams at the top of the formation go under the sandstone capping of the trough, and may be reached from the area not here considered as coal-bearing. Again, the northern portion not here considered in the estimate, will certainly be able to furnish many millions of tons. The strip near the foothills is more certain in its coal-bearing possibilities, as seams reported as high as 20 feet in thickness are found north of the Saskatchewan, and at intervals, smaller ones are known near the boundary, to the south. This area may roughly be called 400

6 miles wide, or over 2,000 square miles. This, with an average of 6 feet of coal, represents a possibility of 11,000,000,000 tons of good lignite: even approaching true coal in many places.

Saskatchewan Areas.[1]

This is the portion of the Edmonton-Laramie previously referred to, which is not subdivided as in Alberta into two formations. The exposures of Laramie coal are mainly in the southern portions of Saskatchewan and Manitoba. Besides the areas shown on the map, it may be noted that, others in the north, especially on the summits of the more elevated portions, may be found by boring through the surface soil, and the possibilities of supplying the northern parts of the treeless country with serviceable fuel will be much increased. Reports of coal seams having been found in well borings near Prince Albert, have also been heard, but no definite information is at hand.

In the Cypress hills, and on the Coteau, these beds occur in the elevated portions of the country; but east of the Coteau there seems to be a basin in which they dip down to the east, and so underlie the area traversed by the Souris river. The erosion of the valley of this stream in its great bend south into Dakota has separated the Souris area from its continuation in southern Manitoba, which is found again in Turtle mountain.

The area that is best known is the vicinity of Estevan on the Souris. Mining has been carried on here for several years. The seams are found exposed on the river banks, and located elsewhere by boring. An 8 ft. seam is mined, though on some of the properties, near Bienfait, this is thickened up to 15 feet. Over a large part there are, per section, at least 7,000,000 tons of lignite available. Eight townships of this vicinity would, therefore, have a possible 2,000,000,000 tons. Coal will be found north to near Weyburn station, and west of this, outcrops have been recorded on the Souris, in tp. 3, R. 15. Along the International Boundary, in about the same longitude, seams are exposed on Big Muddy creek, draining Willowbunch lake. These are of low grade lignite, and the seams are respectively 3 feet and 5 feet in thickness. At the crossing of Poplar river, in tp. 1, R. 29, west of the 2nd meridian, there is an exposure of an 18 ft. seam of lignite of about the same quality of coal as at Souris river.

Near the old Mounted Police post at Wood mountain, seams of 6 and 5 feet respectively have been opened, and have proved good domestic fuel. The same may be said of exposures at Willowbunch settlement. West of this the lignite beds underlie portions of the Swift-current plateau, In the Cypress hills a 4 ft. seam is recorded at the head of Lodgepole creek; so that, with the scattered areas in which coal seams have been found, exclusive of the Souris area, there are nearly 4,000 square miles on which there is good chance of finding coal. This area is capable of producing, for every foot thickness of coal worked, 3,720,000,000 tons, which, with the smallest workable thickness of 4 feet, means 13,000,000,000 tons.

[1] Ann. Report, Vol. I., 1885, part C.
Ann. Report, Vol. XV., 1902-3, part F

CYPRESS HILLS FROM BIG PLUME CREEK 1883

Photo. G. M. Dawson

Manitoba [1]

The elevation called Turtle mountain, near the International Boundary in Manitoba, rises above a plain of denudation which is underlain by shales of the upper part of the Cretaceous. The hill is composed mostly of sandy beds belonging to the top of the formation, some of which are undoubtedly of the same age as the Edmonton series. Lignite seams have been found near the base where the surface deposit is easily penetrated. Higher up the slope there is a thicker mantle of drift, and owing to there being less settlement on the higher ground, this part remains unprospected, so that the known occurrences are as yet confined to the lower slopes. On the summit of the hill coal is reported in two places. The thickest seam so far found is between 6 and 8 feet, representing 5,000,000 to 7,000,000 tons per square mile.

The available area so far known does not exceed forty-eight square miles, but if only a workable seam of 4 feet were found, the available coal for this area would be 160,000,000 tons.

CLASSIFICATION OF COAL.

In the preceding description and estimate of coal content it is intimated that there is a great variety in the quality of the coals there mentioned. Our knowledge of these is gleaned from the analyses which have been made from time to time. In the earliest there seemed to be a tendency to disregard the moisture content, and some of the analyses are results obtained by slow coking. These give a different ratio between the fixed carbon and volatile matter from that obtained by fast coking. Fortunately in the majority of the analyses—especially with those made since 1880—the fast coking process was used, consequently a comparison of the coals so treated is possible. It is also assumed that, none of the samples which reached the assayers retained all the moisture originally contained, but were practically air dried.

Various ratios used.

Various schemes have been suggested for classification. In the classification of English coals, the ratio between the oxygen and hydrogen percentages is used, along with that of total carbon. A suggestion has also been made for a very complex classification, under which certain classes based upon carbon percentages are subdivided according to hydrogen percentage; a classification analogous to a division into generic and specific types. In Pennsylvania, for the harder coals, the practice has been to arrange the coals in order of fuel ratio: that is, the relation between the fixed carbon and the volatile combustible matter. This system of classification answers very well for the eastern coals; but when considerable moisture is present there is less distinction under it between the lignites and the bituminous coals than there should be. A classification of the lower grade coals, according to moisture content, is imperfect,

[1] Summary Report, 1902, p. 191.

as under such a classification well solidified coals that do not break down on drying, but which are high in hygroscopic moisture, fall into the same class as poor lignites with the same moisture content.

Ratio Suggested.

In the scale recently adopted by the United States Geological Survey, namely, the relation between the total carbon and the total hydrogen, ultimate analysis of each sample is necessary; hence the use of this scale is applicable in but few of the records we have at our disposal; but to approximate the same relative scale I have suggested using our proximate analyses and combining both the fuel ratio and the moisture content in what might be called the "split volatile ratio," as discussed in a paper before the Canadian Mining Institute, March, 1908.

In the classification which is introduced on a later page of the series of analyses for the coal fields of the prairie provinces, this ratio is used.

$$\text{Split volatile ratio} = \frac{\text{Fixed carbon} + \frac{1}{2}\text{ Volatile combustible.}}{\text{Moisture} + \frac{1}{2}\text{ Volatile combustible.}}$$

The resultant numerical value for the ratio as above indicated, if applied to the following scale, gives the class to which the coal belongs.

Scale of Ratios.

Anthracite	15 up
Semi-anthracite	13 to 15
Anthracitic coal	10 to 13
High carbon bituminous	6 to 10
Bituminous	3·5 to 6
Low carbon bituminous	3 to 3·5
Lignitic coal	2·5 to 3
Lignite	1·0 to 2·5

To illustrate the working of this scheme, a series of analyses in which the calorific value of the coals is also obtainable, have been recalculated to enable the three elements: water, volatile combustible, and fixed carbon content, to make a constant quantity (in this case 100), and the analyses then plotted, so that, inspection of the diagram will give a better indication of the relative values.

The following table gives (1) the ordinary analysis; and (2) the recalculated amounts for ash free coal. This scheme is shown on diagram No. 1. The diagrammatic method lends itself very readily to comparisons of fuel values. On the upper portion is plotted, for each, the heat value in British thermal units, determined by experiment when reduced to ash free coal.

The great disparity in the results is in some instances known to be due to the samples having been from very much weathered outcrops. Those from inside mines are marked by a cross. These maintain a high average among their associates; but one is evidently given a higher place than it deserves, probably on account of the large percentage of ash in the sample analysed. In the event of a small decrease in ash in the sample

burned in the calorimeter, the result expanded for free coal might easily go too high.

The late experiments on the weathering of coal show enormous losses in calorific power after exposure to the air: and it can be assumed that, the majority of these samples are more or less affected, the mine samples along with the rest suffering thereby.

The only series of tests that we can rely upon as being of fresh coal are, the United States tests inaugurated at St. Louis. An approximate maximum line is drawn on the diagram by inference from the same class of coals from this series.

A minimum line might also, in a few cases, be got by selecting specimens from the outcrop, and testing them.

TABLE OF ANALYSES TO SHOW RANGE OF COALS IN THE DISTRICT. (Expanded analyses calculated for clear coal.)

LIGNITE.

Locality.	Split volatile ratio.	Moisture	Volatile combustible.	Fixed Carbon	Ash.	B. T. U. of Sample	Moisture	Volatile combustible.	Fixed Carbon.	B. T. U. for clean Coal.
South Saskatchewan, 10 miles above Medicine Hat	1·83	16·82	31·90	43·98	7·30	9259	18·14	31·41	47·41	9988
Red Deer river, 7 miles above Hunter hill	2·04	13·06	33·75	44·17	9·02	9046	14·35	37·10	48·55	9943
North Saskatchewan: Big seam	2·12	14·78	30·48	48·67	6·07	9520	15·73	32·45	51·82	10135
Milk River ridge: North slope	2·14	9·84	31·92	39·41	18·80	8964	12·12	39·33	48·55	11044
Red Deer river: mouth of Rosebud river	2·16	13·08	34·50	48·34	4·08	9625	13·64	35·97	50·40	10035
Bow river: Grassy island	2·19	11·90	35·02	47·15	5·93	9853	12·65	37·23	50·12	10047
Prairie creek, Athabaska river: 8 ft. seam	2·21	10·08	37·54	45·07	7·29	10007	10·73	40·49	48·61	10794
Edmonton: seam 6 feet	2·26	12·89	33·79	50·57	2·75	9372	13·25	34·75	52·00	9637
Athabaska, below McLeod river	2·32	11·47	32·09	47·79	8·65	9763	12·55	35·13	51·98	10687
Bow river: Blackfoot crossing	2·39	11·91	33·25	51·51	3·27	9956	12·31	34·33	53·31	10292

LIGNITE COALS.

Belly river, below Little Bow river	2·49	9·18	34·97	49·00	6·85	10478	9·85	36·47	52·61	11247
Belly river: main seam, Coal Banks	2·62	6·50	38·04	47·91	7·55	11129	7·03	41·15	51·83	12038
St. Mary river, 7 miles from Belly river	2·71	7·02	36·47	50·22	6·29	11331	7·49	38·92	53·58	12091

Prairie creek, Athabaska river: seam 30"	2·79	4·80	33·25	13·10	18·91	10116	5·91	41·00	53·15	12475
Upper Belly river	2·89	3·91	38·01	16·75	11·33	11887	4·41	42·87	52·73	13405
Coal creek, Bow river	2·90	4·93	33·55	16·21	15·31	10579	5·82	39·61	54·59	12401
Highwood river, north fork	2·98	6·12	31·92	19·88	12·08	10764	6·96	36·30	56·73	12243

LOW CARBON BITUMINOUS COAL.

Lundbreck, lower seam	3·00	2·36	40·66	47·78	9·20	12236	2·59	44·78	52·19	13176
" upper seam	3·10	3·27	32·53	44·38	19·82	10764	4·07	40·57	55·34	13125
Pincher creek, farm	3·14	5·38	33·19	52·34	9·09	11234	5·92	36·54	57·59	12357
Nanaimo, Wellington mine	3·29	2·75	36·03	52·64	6·58	12567	2·91	39·96	56·35	13352
Pine river, 5 miles above lower forks	3·39	2·45	35·76	48·69	15·10	11831	2·[illegible]	39·76	57·75	13346

BITUMINOUS COAL.

Nanaimo: No. 5, Southfield	1·71	2·08	35·78	56·26	5·60	13251	2·20	37·90	59·90	14046
" Harewood mine	1·73	1·58	33·84	52·17	11·85	12238	1·79	38·30	59·71	13883
" Extension: Tunnel vein	3·89	1·52	35·27	57·04	5·85	13416	1·61	37·66	60·73	14242
Marten creek: Peter seam	4·26	1·79	33·04	61·55	3·62	14190	1·86	34·30	63·84	15835
Comox Union mine: No. 5 pit	4·35	1·08	31·21	57·03	9·60	13261	1·19	34·06	63·75	14619
Mill creek, 4 miles above mill	4·53	1·63	28·43	57·57	12·37	11887	1·83	32·14	65·03	13565
Marten creek, Jubilee seam	4·59	1·89	30·41	63·33	4·37	14417	1·95	31·75	66·30	15108
South Braze[illegible] m No. 6	4·78	3·65	21·31	60·66	14·38	9976	4·26	24·86	70·88	11647
" 5	4·88	2·94	26·10	65·00	5·96	12890	3·13	27·75	69·12	13707
" D seam	4·99	1·20	26·89	61·57	10·34	12156	1·39	30·34	68·27	13480
Comox Un[illegible] " No. 5 pit	5·10	1·32	27·72	63·70	6·72	14191	1·42	29·93	68·65	15213
South Braz[illegible] al seam	5·31	1·70	24·39	62·10	11·81	11976	1·[illegible]	27·66	70·11	13579
" Seam No. 2	5·70	0·94	25·83	66·05	7·20	13510	1·14	27·83	71·18	14558
North Saskatchewan: Cohn creek	5·76	0·92	26·24	68·15	4·70	14043	0·96	27·52	71·51	14734
Living-stone river, Sec. 35, tp. 10, R. 3	5·82	1·75	19·99	58·40	19·86	10945	2·17	24·91	72·92	13659

TABLE OF ANALYSES TO SHOW RANGE OF COALS IN THE DISTRICT. (Expanded Analyses calculated for clear coal). *Concluded.*

HIGH CARBON BITUMINOUS COAL.

Locality.	Split volatile ratio.	Moisture	Volatile combustible.	Fixed Carbon.	Ash.	B. T. U. of Sample.	Moisture	Volatile combustible.	Fixed Carbon.	B. T. U. for clean Coal.
South Brazeau Seam No. 1	6·00	0·90	23·92	65·10	10·08	13200	1·00	26·58	72·42	14669
Bighorn river Seam No. 2	6·29	0·77	23·88	68·10	7·25	13148	0·83	25·75	73·42	14499
North Saskatchewan Cohn creek No. 4	6·45	0·50	23·65	67·75	7·90	13789	0·54	25·68	73·56	14972
South Brazeau Seam No. 4	6·49	0·90	23·62	70·68	4·80	14068	0·95	24·81	74·24	14777
" " 8	6·52	0·63	23·70	69·52	6·15	14146	0·67	25·26	74·07	15073
Bighorn river Seam No. 3	6·79	0·73	22·97	71·45	4·85	13712	0·76	24·14	75·10	14411
Morrissey: 18 ft. seam	6·83	0·90	22·19	70·99	5·60	14346	0·95	23·50	75·21	15197
Coal creek Fernie 8 ft. seam	7·01	0·84	22·38	73·17	3·15	14935	0·85	23·11	76·04	15421
" " 9 ft. seam	7·15	0·92	18·85	64·42	15·65	13757	1·08	22·35	76·56	16309
Michel, highest seam worked	7·28	1·00	20·57	72·93	6·15	14656	1·06	21·92	76·72	15616
Coal creek, Fernie, No 3 mine	7·34	0·92	20·63	72·53	6·00	14284	0·99	21·94	77·00	15196

ANTHRACITIC COAL.

Morrissey: 18 ft. seam	11·52	0·82	11·73	71·60	15·75	12858	0·97	13·92	85·11	15261

SEMI-ANTHRACITE.

Cascade river near Anthracite	14·15	0·71	10·79	80·93	7·57	14134	0·76	11·67	87·54	15292

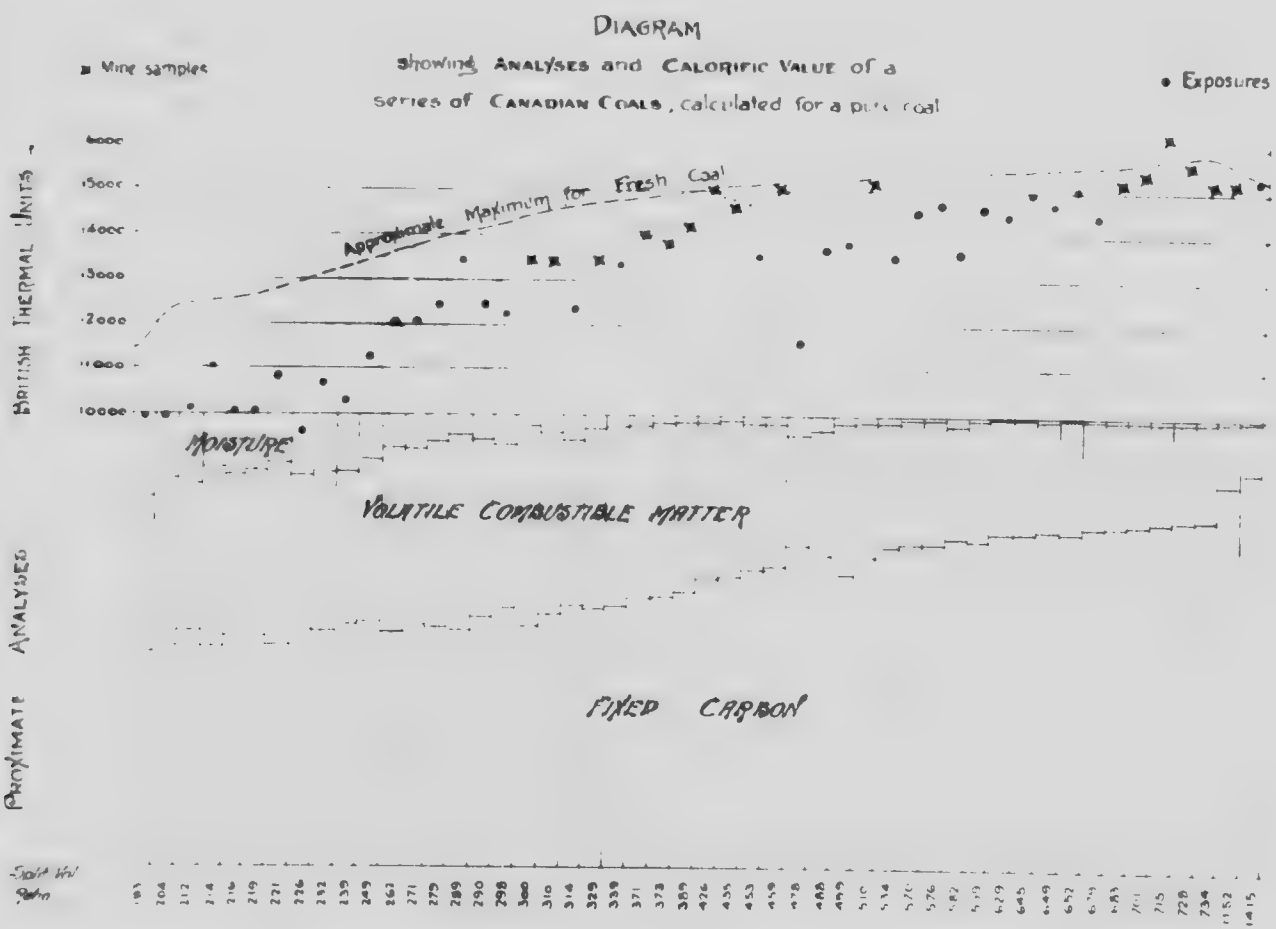
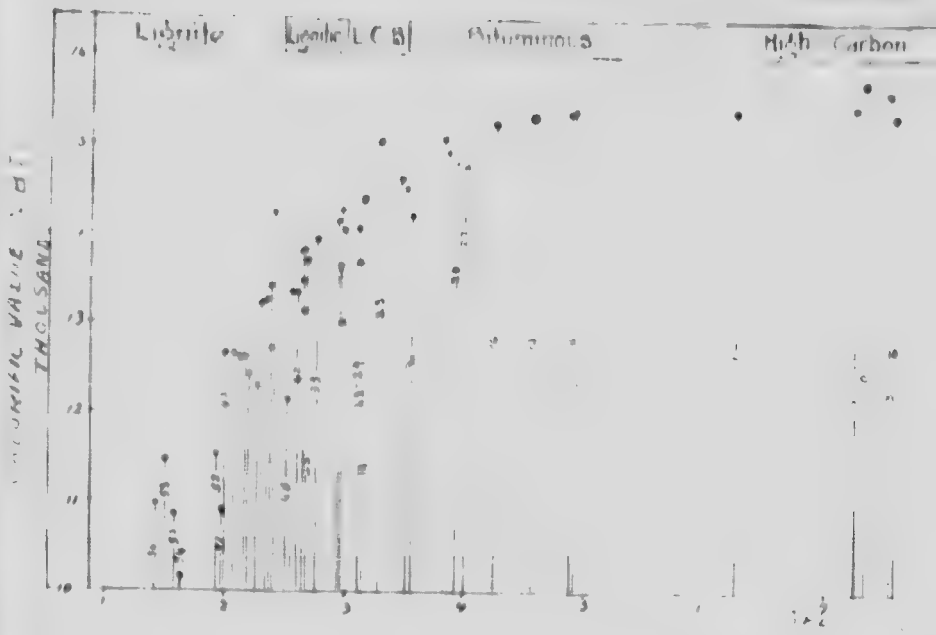


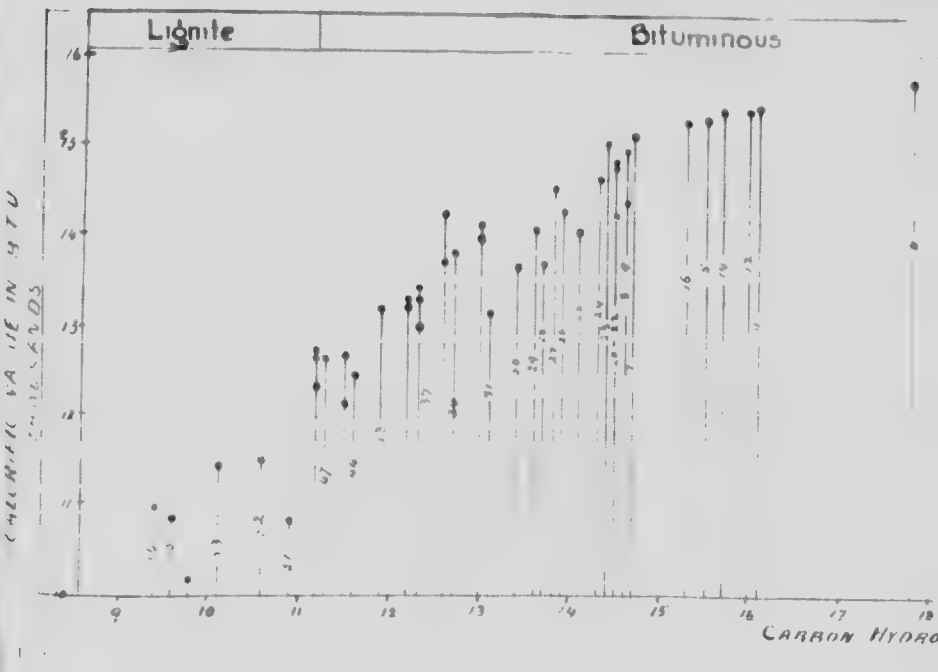
DIAGRAM
Showing ANALYSES and CALORIFIC VALUE of a
series of CANADIAN COALS, calculated for a pure coal
Mine samples
Exposures
BRITISH THERMAL UNITS
PROXIMATE ANALYSES
Approximate Maximum for Fresh Coal
MOISTURE
VOLATILE COMBUSTIBLE MATTER
FIXED CARBON

CLASSIFICATION ADAPTED

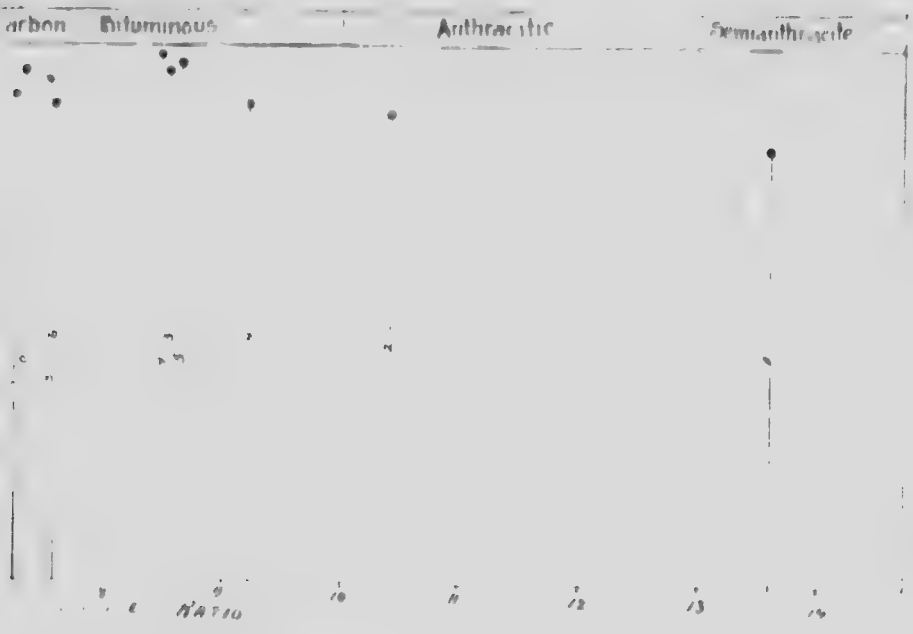


SAME COAL - ARRAN

CLASSIFICATION SUGGESTE

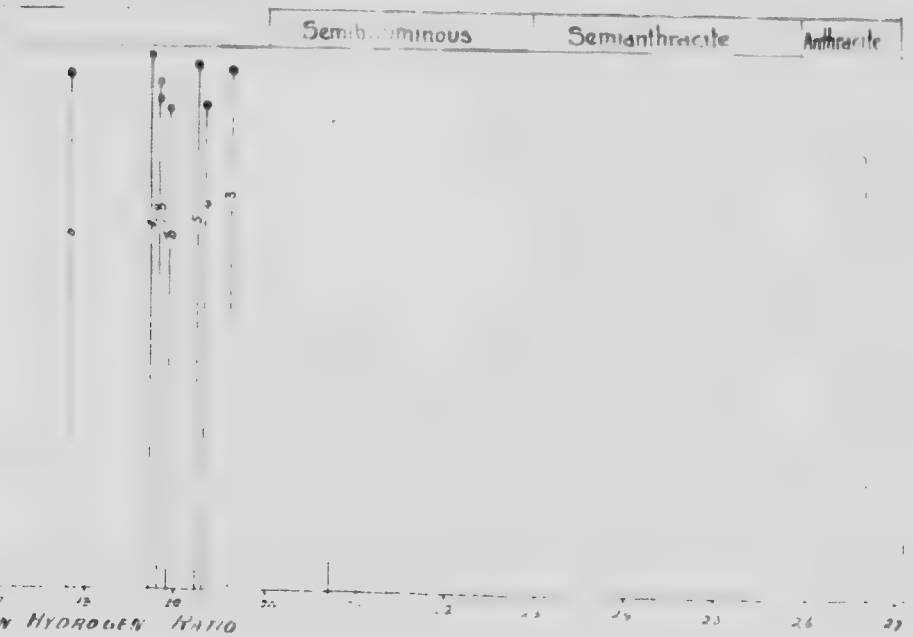


PTED TO CANADIAN COALS



ARRANGED UNDER

GGESTED FOR U.S. COALS.



So far it is apparent that no system of classification can be deemed perfect until the arrangement gives not only a perfect gradation from lignite to anthracite, but also a uniform, increasing or decreasing value in its heating properties. If the arrangement is by calorific value, then the bituminous coals should be at the head.

In order to judge by comparison between the carbon-hydrogen ratios and the split volatile, the series of coals given in the report on the operations of the coal-testing at St. Louis, 1904 (Professional Paper No. 48), page 169, are arranged in diagrammatic form under both ratios, and the calorific values plotted for each. The carbon-hydrogen ratio gives a very acceptable curve for the calorific values; but there are marked variations from it, which show several classed too high, and some too low.

With the same set of specimens, and using the proximate analyses of the air-dried coals, they have been rearranged by the split volatile ratio, and again plotted in the same manner. The curve for the poorer coals is steeper, but the arrangement does not show much more aberration from a normal curve than in the diagram for the carbon-hydrogen ratio. The classification adopted for the Canadian coals seems not to fit this series of analyses, on account of the greater degree of air drying that the Canadian samples have, apparently, been subjected to. The result is that probably, for fresh coals examined in the same manner as the St. Louis samples, the split volatile ratio for lignites should not go much above 2·25, and the other classes be lowered in like proportion.

LIST OF COAL OCCURRENCES, ARRANGED BY SPLIT VOLATILE RATIO TYPE.

In this list the associated coals of Elk river, B.C., are included. Analysis of each will be found in the general list following this: —

ANTHRACITE

	Thickness of seam.	Split volatile ratio
Anthracite mine: Seam A	8'-7"	24·17
" "	3'-10"	16·35
Bankhead: Seam No. 2, B level	8'-0"	15·71
Canmore: commercial sample		15·33
Canmore mine: Seam No. 3	5'-0"	15·30

SEMI-ANTHRACITE.

Panther river, Palliser area: upper seam	5'-0"	14·28
Outcrop near Anthracite	4'-0"	14·15
Marsh mine	12'-0"	13·73
Panther river, Palliser area: lower seam	2'-0"	13·11

ANTHRACITIC COAL.

	Thickness of seam.	Split volat rat
Canmore mine: commercial sample		12·92
" : Sedlock prospect	5′-6″	12·64
Sheep creek: Burns location	8′-8″	12·37
Canmore mine: Sedlock prospect	5′-6″	12·22
Marsh mine: section in gully near	4′-6″	12·17
Sheep creek: Burns location	9′-6″	12·03
Panther river: south branch	4′-0″	11·8[illegible]
Canmore mine: Seam No. 2	4′-0″	11·[illegible]
Marsh mine: section in gully near	4′-6″	1[illegible]
Sheep creek: Burns location	9′-6″	11·63
Blairmore, Alta., coal from near		11·58
Morrissey, B.C.: mine No. 4, steam coal	18′-0″	11·52
Canmore seam at Bow river		11·47
Canmore mine: Seam No. 1	5′-8″	11·19
" : Seam No. 4, outcrop	3′-1″	11·00
Panther river: Costigan seam, east outcrop	4′-4″	11·00
Canmore mine: Seam No. 5	5′-3″	10·51
" : " "	4′-6″	10·48
North edge Costigan area	4′-2″	10·48
Canmore mine: Seam No. in mine	3′-1″	10·34
Marsh mine: section in gully east	4′-0″	10·21
Coxcomb mountain: Sec. 34, tp. 23, R. 7, W. of 5th	3′-0″	10·16

HIGH CARBON BITUMINOUS.

Costigan basin, western upturn: 270 feet from top	3′-6″	9·92
Marsh mine: in gully near	4′-0″	9·92
Panther river: smashed seam at west edge Costigan	11′-0″	9·88
Costigan basin: Seam 164 feet below Costigan seam	3′-9″	9·73
Near Thorne mine, head of Bragg creek	7′-6″	9·64
Kananaskis river, near Tombstone mountain		9·55
Costigan area: seam at D on south side	3′-8″	9·35
Pine river, Canyon creek	1′-0″	9·26
Sheep creek: Secs. 19 and 30, tp. 19, R. 5, W. of 5th	3′-6″	9·00
Coal creek, Fernie: No. 4 mine	22′-0″	8·92
Marsh mine: seam in gully near	10′-0″	8·57
Costigan basin, Scalp Creek area	3′-3″	8·54
Coleman: Seam No. 4, coking	6′-0″	8·51
Marsh mine: seam in gully	15′-6″	8·44
Anthracite: seam near bridge	1′-8″	8·23
Snow creek. At headwaters of	5′-0″	7·90
Sheep creek south: Sec. 36, tp. 19, R. 5, W. of 5th	2′-0″	7·78
Cascade area north of Red Deer river, No. 10	11′-0″	7·63
Michel, B.C.: No. 4 mine 80 feet below highest worked	10′-0″	7·60
Thorne mine: top seam near	1′-6″	7·47
Cascade basin, north of Red Deer river: No. 3	8′-0″	7·42
Coal creek, Fernie, B.C.: upper seam No. 2 mine	6′-0″	7·34
Michel, B.C.: No. 3 mine, highest seam worked	15′-0″	7·28
Elk river	15′-0″	7·27
Coal creek, Fernie: No. 1 mine, seam below 8 ft. seam	9′-0″	7·15
" " "	8′-0″	7·01
Moose mountain: Sec. 8, tp. 23, R. 6, W. of 5th	6′-10″	7·00
North Saskatchewan river, Bighorn river: No. 3	6′-0″	6·98
Morrissey mine No. 1: steam coal	18′-0″	6·83
Cascade basin, north of Red Deer river: No. 5	2′-6″	6·77
South Brazeau river: Seam No. 8	11′-9″	6·50
South Brazeau river: Seam No. 4	5′-10″	6·49

HIGH CARBON BITUMINOUS—*Continued*

	Thickness of seam.	Split volatile ratio.
Peace river, at canyon		6·40
North Saskatchewan river, Cohn creek	7'-6"	6·38
" " Bighorn river: No. 2	4'-0" to 5'-0"	6·35
South Brazeau river: Seam No. 1	4'-10"	5·99

BITUMINOUS COAL.

Cascade basin, Prow mountain, Red Deer river		5·82
Livingstone river, Northwest branch	8'-0"	5·82
Head of Mill and Pincher creeks	8'-0"	5·81
South Brazeau river: Seam No. 2	3'-11"	5·78
North Saskatchewan river, Cohn creek	5'-6"	5·76
Cascade basin, Prow mountain, Red Deer river		5·74
Livingstone river, near mountains	5'-0"	5·69
Coleman: Seam No. 2, steam coal	16'-0"	5·60
North Saskatchewan river, Bighorn river: No. 1	4'-0"	5·53
South Brazeau: Seam No. 5	5'-8"	5·25
" : Kidd seam	8'-0"	5·24
South fork Oldman river, 4 miles above south branch	9'-9"	5·10
South Brazeau river: Big seam	14'-5"	4·99
Frank—coal from within 2 miles		4·83
South Brazeau river: Seam No. 6	8'-5"	4·78
Marten creek: Jubilee seam	30'-0"	4·59
Mill creek, 4 miles above mill	8'-0" to 0'-0"	4·53
Livingstone river: Sec. 35, tp. 10, R. 3, W. of 5th	30'-0"	4·51
Coleman, 4 mile north of: middle seam	2'-10"	4·50
Elk river, Prospect tunnel on Aldridge creek	7'-0"	4·45
Red Deer river, Cascade basin near Prow mountain		4·43
Forgetmenot ridge: Sec. 25, tp. 21, R. 7, W. of 5th	5'-4"	4·40
St. Mary river, at Boundary	1'-6"	4·37
Marten creek, Peter seam	14'-0"	4·26
Sheep Creek south: Sec. 20, tp. 19, R. 4, W. of 5th	5'-0"	4·18
Marten creek, 2nd crossing	2'-0"	3·67
Sheep Creek south: Sec. 30, tp. 19, R. 4, W. of 5th	7'-0"	3·65
Elk river near Station, A10, opposite Elk lake	6'-0"	3·59
Shaws coal mine, Fish creek: Sec. 7, tp. 22, R. 3, W. of 5th	2'-0"	3·54

LOW CARBON BITUMINOUS COAL.

Between Pembina and McLeod Rivers headwaters	24'-0"	3·48
Elk and Kananaskis Rivers headwaters	13'-0"	3·44
Pine river, 5 miles above lower forks	2'-0"	3·39
Bow river near Coal creek: Sec. 22, tp. 27, R. 5	1'-8"	3·38
Pine river, Coal brook	1'-0"	3·32
Belly river: Sherans mine at Coal Banks	5'-6"	3·27
Sheep Creek coal mine: Sec. 2, tp. 20, R. 3, W. of 5th	4'-0"	3·26
Stoney reserve, Morley	6'-0"	3·16
Pincher creek: Government Indian farm	2'-0"	3·14
Lethbridge	5'-6"	3·12
Pincher creek, 4 miles south of		3·10
Crow-nest river, near Lundbreck: upper seam	3'-0"	3·10
Red Deer river, 4 miles below Williams creek	9'-0"	3·09
Pine river, East fork	1'-0"	3·04

LIGNITIC COAL.

	Thickness of seam	Ratio volatile matter
Crows-nest river, near Lundbreck: lower seam	5'-0"	3·90
North Fork of Highwood river, 5 miles above forks	1'-6"	2·98
Coal creek, Bow river	1'-6"	2·90
Upper Belly river, 25½ miles above Waterton river	1'-0"	2·87
North edge of Milk River ridge	1'-6"	2·81
Prairie creek, Athabaska river, above forks	2'-6"	2·79
Bow River coal mine, Coal creek		2·78
Oyster creek, head of Livingstone river, small seams		2·77
Pine river: Coal brook 24 miles east of forks	0'-6"	2·74
St. Mary river, 7 miles from Belly river	3'-8"	2·71
Elk river, small stream at head of	Thin.	2·70
Faber: lower bench	3'-3"	2·62
Belly river: outcrop of main seam Coal Banks	5'-0"	2·62
McPhee mine: Sec. 1, tp. 10, R. 17, W. of 4th	2'-7"	2·53
Rocky Mountain House seam	2'-0"	2·50
Belly river, 5 miles below Little Bow river	3'-3"	2·49

LIGNITE.

Athabaska river, above McLeod river	3'-0"	2·46
Blackfoot crossing, Bow river, 6 miles east of	4'-8"	2·39
Kneehills creek, R. 23, west of 4th	4'-0"	2·35
Faber mine, upper bench	0'-5"	2·38
Red Deer river, 4 miles below Tail creek	3'-0"	2·34
Athabaska river, above McLeod river	10'-0"	2·32
Prince Albert: drift coal		2·32
McLeod river, near Grand Trunk Pacific railway, tp. 54		2·33
Wolf creek, branch of McLeod river: tp. 52, R. 15, west of 5th		2·32
Smoky river, 5 miles below Lower Smoky river	0'-24"	2·31
Red Deer river, 12 miles above Tail creek	7'-0"	2·30
Meeting creek, 2 miles from Battle river	4'-6"	2·28
North Saskatchewan: near Edmonton	6'-0"	2·26
" " : Ross seam	4'-0"	2·25
Crowfoot creek, Bow river	6'-0"	2·24
Prairie creek, Athabaska river, Coal Creek branch	8'-0"	2·21
Grassy island, Bow river	4'-6"	2·19
Bragg creek, 4 miles up: Sec. 7, tp. 22, R. 5, west of 5th	2'-6"	2·19
Bow river, 4 miles below Blackfoot crossing	4'-6"	2·18
Saskatchewan river. Big seam above Edmonton	26'-0"	2·18
Pembina river, near Grand Trunk Pacific Railway crossing	6'-0"	2·18
Red Deer river, mouth of Rosebud	6'-0"	2·16
Crowfoot creek, Bow river	1'-6"	2·16
Souris river, tp. 3, R. 15, west of 2nd	1'-6"	2·15
Milk River ridge, seam on north slope	1'-6"	2·14
McLeod river: Jocks crossing, tp. 53, R. 16, west of 5th		2·13
Pembina river: part of big seam	13'-0"	2·13
" " "	13'-0"	2·11
Saskatchewan river: part of Big seam	26'-0"	2·12
Ege creek, North Saskatchewan river	1'-1"	2·10
Red Deer river 2 miles below Rosebud river	5'-0"	2·07
Crowfoot creek: from 135 feet down shaft	9'-0"	2·06
Near Pembina river, tp. 52, R. 7, west of 5th		2·04
Red Deer river, 7 miles above Hunter hill	3'-6"	2·04
Pembina river: Secs. 27 and 28, tp. 53, R. 7		2·03
Kneehills creek		2·00

LIGNITE—*Continued.*

	Thickness of seam.	Split volatile ratio
Moose river, below Long Portage, Ont.		
Red Deer river, 13 miles above Hunter hill		1·99
Jumpingpound creek (Towers): Sec. 19, tp. 25, R. 4		1·98
Horseshoe Bend, Bow river	4′-6″	1·98
South Saskatchewan river, 10½ miles above Medicine Hat	4′-6″	1·97
Wood mountain, First hill, lowest seam	4′-0″	
Sanders river, Swan river, Man. (small)	5′-0″	1·93
Fort Francis, Rainy river, (loose)		1·92
Red Deer river, 9 miles above Hunter hill		1·86
South Saskatchewan river, Medicine Hat: 10 miles above	1′-6″	1·83
Bow river, Horseshoe Bend	4′-0″	1·83
Wood mountain, near 3rd meridian	4′-4″	1·83
Long creek, S. of Estevan: Sec. 22, tp. 1, R. 8, west of 2nd	Thin.	1·80
Souris river north side, 1 mile west Short creek	7′-0″	1·77
South of Lac la Ronde, Sask. Reported at	2′-3″	1·76
Wood mountain, Hay flat	5′-0″	1·76
Souris river near mouth of Long creek	6′-0″	1·72
" Selwyn's Borehole: Sec. 6, tp. 2, R. 5 west of 2nd	3′-2″	1·70
Cypress hills, branch of Lodge creek	6′-0″	1·68
Towtinow river, tp. 63, Alberta	4′-0″	1·61
Stair, South Saskatchewan river		1·61
" from 320 feet in, at No. 6 level	5′-0″	1·59
Souris river, near mouth of Long creek	5′-0″	1·55
Long creek: Sec. 14, tp. 1, R. 8, west of 2nd	1′-0″	1·58
Wood mountain, First hill	7′-0″	1·50
Poplar river. (Porcupine creek)	8′-0″	1·49
Souris river. Sutherland mine	18′-0″	1·49
Souris river near mouth of Long creek	4′-0″	1·42
Big Muddy creek at Boundary	1′-5″	1·38
" "	4′-0″	1·31
" "	5′-0″	1·31
Souris river near Roche Percee	3′-0″	1·30
Souris river near mouth of Long creek		1·30
Big Muddy creek, lowest lignite thin	6′-6″	1·28
		1·37

ANALYSES OF COALS.

Reference numbers in tables are for the following publications:—

1. Report on the efficiency of various coals used by the United States Ships, 1893-95. Bureau of Equipment, Washington, 1895.
2. Report on the efficiency of various coals used by the United States Ships, 1895-96. Bureau of Efficiency, Washington, 1897.
3. Report on the efficiency of various coals used by United States Ships, 1896-98. Bureau of Equipment, Washington, 1899.
4. Operations of the coal-testing plant at St. Louis, 1904. United States Geological Survey, Professional Papers, No. 48.
5. Preliminary report on the fuel testing plant, St. Louis, 1905. Bull. United States Geological Survey, No. 290
6. Report of Minister of Mines, B. C., 1902.
7. Reports Geological Survey, Canada, to Vol. XVI

8. Report of the Department of the Interior, Canada, 1881, p. 52.
9. Second Report of Progress in the laboratory of the Second Geological Survey of Pennsylvania, 1876-78, by A. S. McCreath.
10. Report Michigan Geological Survey, 1905.
11. Summary Report, Geological Survey, Canada, 1906.
12. Report of the Section of Chemistry and Mineralogy, G. S. C., No. 958.
13. Cascade Coal Basin, by D. B. Dowling, No. 949.
14. Unpublished analyses by F. G. Wait, Geological Survey, Canada.
15. Summary Report, Geological Survey, Canada, 1907.
16. Report on the 49th Parallel, by G. M. Dawson.
17. Moose Mountain district, Alberta, by D. D. Cairnes. No. 968
18. Report of Minister of Mines, B. C., 1901, p. 1185.
19. Report of Minister of Mines, B. C., 1906, p. 119.
20. Report Michigan Geological Survey, 1904, p. 127.
21. Geological Survey of Pennsylvania, 1895.
22. Geological Survey of Pennsylvania, 1886, Pt. 1, p. 267.
23. Geological Survey of Pennsylvania, Report of Laboratory, 1876-78.
24. Minerals of Nova Scotia, by E. Gilpin, Halifax, 1901.

Analyses of Canadian coals are generally made from small samples, which are, probably, more or less air-dried. The United States coals in the first five references are from large lots fresh from the mine. The air drying loss is, therefore, given along with the analysis of the air dried sample.

KOOTANIE COALS—ELK RIVER, B.C.

Localities.	Thickness of Seam.	Split Vol ratio.	Moisture	Volatile matter.	Fixed Carbon.	Ash	Sulphur.	Calorific value in B T U	Reference No.
Headwaters Elk river—									
Seam at Height of land, 15 ft	13'-0"	3·44	9·10	21·00	57·00	12 90			14
Seam at Height of land, south side small seam		2 70	3·36	45·27	47·70	3·67			14
Seam opposite Elk lake in centre of valley	6'-0"	3 59	1 90	30 06	56 60	8·44			14
Prospect tunnel on Aldridge creek	7'-0"	4 45	1·60	32 47	63 44	2·49			14
Seam on Elk river	15'-0"	7 27		21·76	68 20	10 04			7
Michel									
Mine No 3 highest seam worked	15' 0" to 30'-0"	7·28	1·00	20·57	72 00	6·15	0 28	14656	6
Mine No. 4, 80 ft below highest seam	10' 0" to 30'-0"	7·60	1 00	18·93	70 13	9·50	0 44	13850	6
Fernie—									
Mines Nos 1 and 2, Coal creek	8'-0" and 6'-0"	7·01	0 84	22·38	73·17	3 15	0 46	14945	6
No 1 mine, seam 9 ft below 8 ft. seam	9'-0"	7·15	0 92	18 85	64 42	15 65	0·16	13757	6
No. 3 mine, Coal creek, upper seam of No. 2 mine	6'-0"	7·34	0·92	20 63	72 05	6 00	0 40	14284	6
No 4 mine, Coal creek, 750 ft. below No 1	22' 0"	8 92	0·96	13·46	61·92	23 50	0 16	12114	6
Morrissey									
Mine No 1, steam coal	18'-0"	6 83	0 90	22·19	70 99	5 60	0 32	14346	6
Mine No. 2 steam coal	18' 0"	11·52	0 82	11 73	71·50	15 75	0·20	12858	6
Marten creek									
Jubilee seam, 2nd crossing	30'-0"	4·59	1 80	30 11	63 33	4 37	0 48	14447	7
Peter seam 2nd crossing	14' 0"	4·26	1·79	33 04	61 55	3 62	0 51	14490	7
Small seam, 2nd crossing	2' 0"	3·67	2 12	26 92	43·48	27 48			7
Cannel coal, "Bird-seye splint"			2.10	57 71	30 33	9 86			

KOOTANIE COALS ALBERTA.

Coleman Area

Localities.	Thickness of Seam	Split Vol. ratio.	Moisture	Volatile matter.	Fixed Carbon.	Ash.	Sulphur.	Calorific value in B.T.U	Reference No.
									G. H. Dickson.
Steam: No. 2 seam, Coleman. Average of 2 analyses	16'-9"	5·60	0·45	25·42	61·10	13·03	.....	.....	"
Coking: No. 4 seam, Coleman. Average of 2 analyses	6'-0"	8·51	0·74	16·61	68·65	13·50	.....	.....	7
Half mile north of Coleman. Middle seam	2'-10"	4·50	1·82	24·55	51·22	22·41	.....	.....	

Blairmore-Frank Area.

Coal from near Blairmore	.....	11·53	1·22	11·70	75·67	11·41	.....	.....	7
Two miles from Frank	.....	4·83	0·71	29·78	61·49	8·02	.....	.....	14
South fork Oldman river, 4 miles above south branch	9'-9"	5·10	1·93	23·23	57·50	17·34	.....	.....	7

Livingstone Area.

Living-stone river, Sec. 35, tp. 10, R. 3, west of 5th	30'-0"	4·51	1·03	32·20	61·28	5·49	.....	.....	12
" " "	5'-0"	5·69	1·75	19·99	58·40	19·86	.....	10047	7
" " "	8'-0"	5·82	1·24	24·62	66·61	7·53	.....	.....	7
Living-stone river, northwest branch	9'-6"	12·03	1·30	11·14	77·13	10·43	.....	.....	7
Sheep creek, south branch near Burns location, Sec. 11, tp. 17, R. 7, west of 5th	9'-6"	11·61	0·52	13·19	76·00	10·29	.....	.....	14
	8'-8"	12·37	0·74	11·51	74·71	13·04	.....	.....	14
Sheep creek, Burns location									12
North end of area near Tombstone mountain, Kananaskis river	.....	9·55	0·87	13·66	66·72	18·75	.....	.....	

Moose Mountain Area.

Forgetmenot ridge, sec. 25, tp. 21, R. 7, west of 5th	5′-4″	4·40	6·68	20·68	64·71	7·93		17
Sheep creek, secs. 19 and 30, tp. 19, R. 5, west of 5th	...	9·00	0·53	14·99	64·55	19·93		17
Sheep creek, sec. 36, tp. 19, R. 5, west of 5th	3′-0	7·78	0·69	19·98	73·12	6·21		17
Coxcomb mountain, sec. 34, tp. 23, R. 7, west of 5th	3′-0″	10·16	1·64	14·26	82·01	2·09		17
Near Thorne mine, Moose mountain. Top seam	1′-6	7·47	1·86	19·23	76·07	2·84		17
Near Thorne mine, Head of Bragg creek	7′-6	9·64	1·17	13·54	69·77	15·52		17
Moose mountain, sec. 8, tp. 23, R. 6, west of 5th	6′-10″	7·00	2·71	18·62	75·52	3·42		17

Cascade Area.

[illegible]	12′-0″	13·73	0·70	11·03	79·78	8·49		7
[illegible]	10′-0″	8·57	1·02	7·24	36·16	15·58		7
[illegible]	15′-6″	8·44	3·50	13·10	77·90	5·50		13
	4′-0″	9·93	2·60	12·40	81·20	3·80		13
	4′-6″	11·62	1·00	12·50	78·00	8·50		13
	4′-0″	10·21	2·50	11·50	78·50	7·50		13
	4′-6″	12·17	2·50	9·50	83·50	4·50		
[illegible] prospect	5′-6″	12·22	0·92	12·78	82·90	2·55	0·75	13
	5′-6″	12·64	0·04	14·03	82·11	2·82	1·07	13
[illegible] river near [illegible]	...	11·47	1·60	12·23	82·32	3·85		7
[illegible] Commercial sample		12·92	1·97	9·93	84·61	3·29	0·20	2
		15·33	1·10	9·716	86·567	2·67	0·14	1
[illegible] mine, Seam No. 6	4′-6″	10·48	0·49	16·04	81·11	2·33		13
No. 5	5′-3″	10·47	1·10	14·66	78·38	5·20	0·66	13
No. 3	5′-3	10·51	2·00	12·90	82·40	2·70		13
No. 1 outcrop	3′-1	11·00	1·25	13·52	81·30	3·47	0·46	13

KOOTANIE COALS ALBERTA (Co[illegible])

Cascade Area—Contin[illegible].

Locality	Thickness of Seam	Split Vol. ratio	Moisture	Vol. comb. matter	Fixed Carbon	Ash	Sulphur	Calorific value B.T.U.	Reference No.
Canmore mine Seam No. 1 in mine	[illegible]	10·34	0·72	15·73	80·90	2·65			12
" Seam No. 1	8"	11·19	0·43	15·40	81·74	2·73			13
" Seam No. 2	4'-0"	11·82		14·70	79·00	6·30			13
Seam No. 3	5'-0"	15·30		11·80	84·40	3·80			13
Cascade river oppo[illegible] Bankhead lower	1'-8	8·23	2·07	15·84	74·35	7·74			7
Cascade river exposure oppo. Bankhead upper	4'-0	14·17	0·71	10·79	80·93	7·57		14134	7
Anthracite probably Seam No. 3	3'-10"	16·3[illegible]	1·04	9·15	87·18	2·63			7
Anthracite mine Sea[illegible]	8'-7"	24·17		7·65	88·72	3·63			13
Bankhead Seam No. 2 [illegible]	8'-0"	15·7[illegible]	0·43	10·65	85·02	3·90			12
Snow creek branch of Panther river	5'-0"	7·90	0·72	21·28	75·80	2·20			
Seams near Prow mountain		5·84	2·14	23·83	69·67	4·37			15
North side Red Deer river near Prow mountain		5·74	1·58	25·08	68·60	[illegible]			15
South side Red Deer river near Prow mountain		4·43	2·90	29·26	62·95	4·89			7
Between Red Deer and Cascade river [illegible] seams in [illegible] section									
Seam No. 3	8'-0"	7·42	1·55	18·75	71·20	8·50			15
Seam No. 5	2[illegible]	6·77	2·05	20·75	73·12	4·08			15
Seam No. 10	11'-0"	7·63	1·2[illegible]	19·61	74·17	5·02			15

Palliser Area.

Locality	Thickness of Seam	Split Vol. ratio	Moisture	Vol. comb. matter	Fixed Carbon	Ash	Sulphur	Calorific value B.T.U.	Reference No.
South of [illegible] Upper seams	5'-0	14·28	0·93	10·58	8[illegible]·55	1·94			13
" Lower seam	2'-0	13·41	1·13	11·59	84·94	2·34			13

Costigan Area.

South branch, Panther river	4' 7"	11·85	1 52	11 65	81 16	5 67			7	
Panther river, eastern outcrop, Costigan seam	4' 4"	11 00	1 14	13 63	80 64	4 59			7	
Panther river, western outcrop, Costigan seam	4' 9"	10 00	0 69	15 75	77 15	6 41				
North edge of area south of Red Deer river	4' 2"	10 48	1 80	13 11	81 01	4 08			15	
North edge of area south of Red Deer river	5' 4"	9 05	2 14	15 01	79 73	3 12			15	
Western outcrop, Panther river, 164 feet below Costigan seam	3' 9"	9 73	0 79	15 66	76 05	7 50			7	
270 feet below Costigan seam, north side	3' 6"	9 92	0 61	16 49	79 56	3 34			7	
270 feet below Costigan seam, south side	3' 8"	9 35	1 14	16 27	78 61	3 98			15	
Lowest seam near fault line	11' 0"	9 88	1 87	13 74	79 55	4 84			7	
Scalp Creek area, west of trail north of Red Deer	3' 3"	8 54	1 90	16 10	76 89	5 11			15	

Bighorn Area.

Cobn creek, North Saskatchewan R										
Seam No 1	2' 2"	4 06	5 80	25 50	62 60	6 10			14	
Seam No 2	1' 10"	4 89	3 74	25 50	67 00	3 76			14	
Seam No 3, average of 2 analyses	5' 6"	5 76	1 38	25 59	68 92	4 10		14041	14	
Seam No 4, average of 2 analyses	7' 6"	6 38	0 79	23 58	68 51	7 50	0 65	13789	14	
Bighorn river										
Seam No 2, average of 3 analyses	4' 6"	6 35	0 99	23 17	68 24	7 60	0 57	13448	14	
Seam No 3, average of 3 analyses	6' 0"	6 98	0 87	21 46	70 38	7 29	0 66	13712	14	
	1' 7"	4 61	2 00	28 55	60 55	8 50			14	
South Brazeau river, top seam										
Top seam, average of 3	14' 5"	4 99	1 85	26 99	62 78	7 37	0 45		11 to 14	
Bottom seam, average of 3	8' 0"	5 24	1 04	24 58	62 48	11 90	0 56		14	
South Brazeau river, average of 3 analyses										
Seam No 8	11' 9"	6 50	1 05	22 58	68 99	7 37	17	14146	14	

KOOTANIE COALS- ALBERTA *Continued.*

Bighorn Area Continued

Localities.	Thickness of Seam	Split Vol. ratio.	Moisture	Volatile matter	Fixed Carbon.	Ash	Sulphur	Calorific value in B.T.U.	Reference No.
South Brazeau river, average of 3 analyses —*Continued.*									
Seam No. 1	4′ 10″	5·99	1·12	23·74	65·93	9·19	0·81	13200	14
Seam No. 2	3′ 11″	5·78	1·28	24·59	66·26	7·87	0·60	13510	14
Seam No. 4	5′-10″	6·49	1·18	23·18	71·08	4·56	0·52	14068	14
Seam No. 5	5′-8″	5·25	3·07	24·07	67·33	5·52	0·59	12890	14
Seam No. 6	8′-5″	4·78	3·93	21·14	61·96	12·92	0·43	9976	14

BELLY RIVER COAL.

Areas in Foothills.

Oyster creek, in mountains head of Livingstone river	Small.	2·77	4·03	31·82	39·46	24·69	.....	.....	7
Mill and Pincher creeks: sec. 10, tp. 5, R. 1, west of 5th	8′-0″	5·81	1·99	20·88	61·87	15·26	.....	.....	17
Mill creek, 4 miles above mill	8′-0″	4·53	1·03	28·43	57·57	12·37	.....	11887	17
St. Mary river near Boundary	1′-6″	4·37	5·05	25·30	64·65	5·00	.....	.....	16
Sheep creek, South branch: sec. 20, tp. 19, R. 4, west of 5th	5′-0″	3·78	2·16	34·65	56·42	6·77	.....	.....	17
Sheep creek, South branch: sec. 30, tp. 19, R. 4, west of 5th	7′-0″	3·65	2·50	35·88	56·64	4·98	.....	.....	17
Bragg creek: sec. 7, tp. 23, R. 5, west of 5th	2′ 6″	2·19	9·31	35·59	41·72	13·38			17
Stoney Reserve, Morley	6′ 0″	3·16	1·26	41·30	48·60	8·84			7

Lethbridge Medicine Hat Area.

North side Milk River ridge	1' 6"	2 14	9 84	31 92	39·41	18 83				
North side Milk River ridge, 1½ miles east Fossil coulee	1' 6"	2 81	5 58	37·77	49·85	6 80	8964			
St. Mary river, 7 miles from Belly river	3' 8"	2 71	7 02	36·47	50 22	6 29	11331			
Lethbridge. Analysis supplied by T. Denis	5' 6"	3 12	4 37	34·61	50 43	9 89				
Coal Banks, Sherans mine	5' 6"	3 27	6 52	31 03	56 54	5 91				
Coal Banks, Sherans mine, outcrop	5' 6"	2 62	6 50	38 04	47·91	7 55				
Taber coal mines: upper bench	6' 5"	2 38	11 36	26 64	45 60	16 40	11129			
" " lower bench	3' 3"	2 62	10 82	27·84	50 93	10 41				
" " average 2 analyses	3' 3"	2·46	7·21	39·18	46 36	7 22				
McPhee mine: sec. 1, tp. 10, R. 17, W of 4th	2' 7"	2 53	11·35	29 98	51 63	7 04		11		
Belly river, 5 miles below Little Bow river	3' 5"	2 19	9 18	34 97	49 00	6 85				
Grassy island, Bow river	4' 6	2 19	11 90	35 02	47 15	5 93	10478			
Red Deer river, 7 miles above Hunter hill							9855			
Red Deer river, 9 miles above Hunter hill	3' 6"	2 04	13 06	33 75	44 17	9 02	9616			
Red Deer river, 13 miles above Hunter hill	1' 6"	1 83	13 63	34 01	39 11	13 2.				
South Saskatchewan river, 10½ miles above Medicine Hat	1' 3"	1 98	12·62	35 9	42 81	8 58				
South Saskatchewan river, 10 miles above Medicine Hat	4' 0"	1·94	17·70	29 90	48 56	3 84				
Stair, No. 6 level, 320 feet in	4' 0"	1 83	16 82	31 90	43 98	. 30				
Stair, outcrop of main seam	5' 0"	1 55	20 54	33 26	41 15	5 05	9259			
	5' 0"	1 59	19 90	33·53	41 58	5 16				

Peace River District

Peace river at "Canyon of Mt. of Rocks"	0' 6"	6 10	2 10	21 54	71 63	4 . 3				
Pine river 5 miles above lower fork	2' 0	3 39	2 45	33 56	48 69	15 50	11433			

BELLY RIVER COAL *Continued*

Peace River District - Continued.

Localities.	Thickness of Seam.	Split Volatile ratio	Moisture	Volatile matter.	Fixed Carbon.	Ash.	Sulphur.	Calorific Value in B.T.U.	Reference No.
Pine river, Coal brook, 2½ miles east of Forks	0'-6"	2·77	7·83	34·21	52·09	5·87	.....		7
Pine river, Coal brook, 2½ miles east of Forks	1'-0"	3·32	1·39	23·11	31·38	44·12	.....		12
Pine river, Canyon creek	1'-0"	9·26	0·67	17·23	77·34	4·76	.....		12
Pine river, East Fork	1'-0"	3·01	1·70	43·76	50·19	4·44	.....		12
Smoky river, 5 miles below Little Smoky river	0'-2½"	2·31	11·52	34·83	49·47	4·18	.....		7

EDMONTON COALS.

Foothills, Western Portion.

Upper Belly river, northern part: tp 3, R. 27	1'-0"	2·87	3·91	38·01	46·75	11·33	.....	11887	7
	2'-0"	3·14	5·38	33·19	52·34	9·09	.....	11234	7
Indian Farm, Pincher creek									
Four miles south of Pincher creek near above		3·10	6·26	31·96	53·05	8·73	.....		7
Crowsnest river, near Lundbreck, upper	3'-0"	3·10	3·27	32·53	44·38	19·82	.....	10764	7
Crowsnest river, near Lundbreck, lower	3'-0"	3·00	2·36	40·66	47·78	9·20	.....	12236	7
	1'-6"	2·98	6·12	31·92	49·88	12·08	.....	10764	7
Highwood river, N. Fork 5 miles up									
Jumpingpound creek, (Towers mine) N.W. ¼ sec. 19, tp. 25, R. 4, west of 5th	4'-6"	1·98	5·00	52·10	35·20	7·07	.....		17

Fish creek, (Shaws mine): sec. 7, tp. 22, R. 3, west of 5th	2' 0"	3·54	3·76	37·91	56·37	5·96			17
Sheep Creek coal mine: sec. 2, tp. 20, R. 3, west of 5th	4' 0"	3·26	3·08	39·37	54·50	3·05			7
Bow river, near Coal creek: sec. 22, tp. 27, R. 5, west of 5th	1'-8"	3·38	2·79	36·90	53·40	6·91			7
Coal creek, Bow river, outcrop of seam	4' 6"	2·90	4·93	33·55	46·21	15·31		10579	7
Bow river, Bow River mine, south side		2·78	4·41	40·32	48·27	7·00			7
Red Deer river, 4 miles below Williams creek	9'-0"	3·09	4·97	36·87	54·05	4·11			7
Rocky Mountain House seam, average of 3	2' 6"	2·50	7·44	36·56	46·02	7·85			7
Head of Pembina and McLeod rivers	21'-0'	3·48	4·32	33·43	56·49	5·11	0·17		14
Wolf creek: tp. 52, R. 15, west of 5th		2·32	8·57	40·39	46·74	1·30			14
McLeod river, Jocks crossing		2·13	10·21	38·17	43·52	8·10			14
McLeod river near G.T.P., tp. 54		2·33	9·47	39·24	48·25	3·01			14
Prairie creek, Athabaska river, Coal Creek branch: average of 3	2' 6"	2·79	4·80	33·25	43·10	18·91	0·38	10116	14
Prairie creek, Athabaska river, Coal Creek branch: average of 3	8' 0"	2·21	10·08	37·54	45·07	7·29	0·32	10007	14
Athabaska river, 20 miles above McLeod river	10' 0"	2·52	11·47	32·09	47·79	8·65		9763	7
Athabaska river, 20 miles above McLeod river, lower seam	3' 0"	2·46	10·58	32·79	50·19	6·44			7

Eastern Portion of Formation.

Bow river, Horseshoe bend	4' 4"	1·83	13·67	37·16	40·50	8·67			14
Blackfoot crossing, Bow river, in coulee 6¾ miles east of crossing on south side of seam, 1 ft. of shale near top		1·97	11·13	38·75	40·93	9·19			14
Bow river, 4 miles below Blackfoot crossing	4' 8"	2·39	11·91	33·25	51·57	3·27		9956	7
Crowtoot creek, 4 miles from Bow river	4' 6"	2·18	10·72	32·63	42·72	13·93			7
	6' 0"	2·21	11·25	35·59	47·24	5·92			7

EDMONTON COALS *Continued*

Eastern Portion of Formation Continued

Localities.	Thickness of Seam.	Split Volatile ratio	Moisture	Volatile combustible	Fixed Carbon	Ash	Sulphur	Calorific Value in B.T.U.	Reference No.
Crowfoot creek, upper seam near mine	1' 6"	2·46	13·20	33·80	48·10	4·90			
Crowfoot creek, bottom of shaft at mine	9' 0"	2·06	10·35	34·40	39·61	15·64			
Red Deer river, 2 miles below Rosebud river	5' 0	2·07	14·20	34·22	47·91	3·67			
Red Deer river, mouth of Rosebud river	6' 0	2·46	13·08	34·50	48·34	4·08		9025	
Red Deer river, 4 miles below Tail creek	3' 0'	2·31	10·02	32·11	45·19	12·68			
Red Deer river, 12 miles above Tail creek	7' 0"	2·30	7·66	25·90	34·53	31·91			
Knechills creek		2·00	13·28	36·39	43·84	6·91			
Knechills creek, R. 23, west of 4th	1' 0"	2·35	9·86	34·9	46·57	8·67			
Meeting creek, 2 miles from Battle river	1' 6"	2·28	11·68	37·2	49·87	2·62			
Egg creek, North Saskatchewan river	1' 1"	2·10	11·91	36·39	45·04	6·66			
North Saskatchewan river, Ross seam, Edmonton	4' 0"	2·25	11·47	36·12	48·57	3·84			
North Saskatchewan river, Edmonton	6' 0"	2·26	12·89	33·79	50·57	2·75		9372	
" " Big seam	26' 0"	2·12	14·78	30·48	47·67	6·07		9520	
" " " average of 3		2·18	11·88	35·31	47·06	5·08			
Towtinow river, tp. 63		1·61	19·45	34·34	44·86	1·35			
Pembina river, tp. 52, R. 7, west of 5th		2·04	10·87	33·45	51·70	3·97			
Pembina river, sec. 27 and 28, tp. 53, R. 7, west of 5th		2·03	14·58	34·82	47·60	3·00			
Pembina river, sec. 33, tp. 53, R. 7, west of 5th	13'-0"	2·11	12·93	34·96	45·11	10·00			
Pembina river, sec. 33, tp. 54, R. 7 west of 5th	25' 0"	2·13	13·78	32·01	47·35	6·86			
Pembina rive, at old C.P.R. location	6' 0"	2·18	13·07	32·03	47·56	7·34			
West end Cypress Hill, Lodge creek	4' 0"	1·61	16·37	35·58	37·23	10·82			

LARAMIE COALS.

Saskatchewan Areas.

Wood mountain, 1st hill, highest	8'-0"	1·49	18·61	39·11	37·57	4·71
Wood mountain, 1st hill, lowest	5'-0"	1·93	12·26	41·51	43·07	3·16
Wood mountain near 3rd meridian, average of 2	Thin.	1·80	16·51	34·17	43 62	5·69
Wood mountain, Hay flat	6'-0"	1·72	13·73	38 91	38 54	5·82
Wood mountain, Poplar river at Boundary, average of 2	18' 0"	1 49	14·46	43 90	32 66	8 97
Big Muddy creek at Boundary	4' 0"	1·31	15 51	51 33	28 44	4·72
" "	5' 0"	1·31	16·28	50 26	29 18	4 28
Big Muddy creek at Boundary, lowest seam	3'-0"	1·30	15·20	51·27	27·61	5 92
Dirt hills, Middle bluff, lowest seam		1·27	18·74	46·19	30 04	5 03
Souris river, tp. 3, R. 15, west of 2nd	6'-0"	1·87	15 50	35 96	44 78	3 76
" mouth of Long creek, top	1' 6"	2·15	13 85	30 93	47 90	7 30
" "	6' 6"	1 28	17 97	47 32	30·10	4 61
" "	1' 0"	1·58	14 90	43 24	36 68	5 18
" "	1'-5"	1 38	12 67	53·90	28 01	6 42
Souris river, sec. 22, tp. 1, R. 8, west of 2nd	3' 2"	1·70	13 94	41 92	38 35	5·79
Souris river, sec. 14, tp. 1, R. 8, west of 2nd	7' 0"	1·77	15·41	38 66	41 67	4 56
Souris river, N. side, 1 mile west of Short creek	7' 0"	1 50	14 73	48 40	34·07	2 80
Souris river, Sutherland's mine	2' 3"	1 76	12 07	46 28	38 90	2 75
Souris river, near Rocta Percee	4' 0"	1 42	21 84	35 12	38 64	4 40
Souris river, Selwyn's borehole, sec. 6, tp. 2, R. 5		1·30	20 29	31 41	31 35	16 95
	6' 0"	1 68	17 78	32 70	41 17	8 35

Outlying Localities, Horizon not Definite.

Drift coal, 7 miles below Prince Albert	2 32	10 12	35 98	47 27	6 63

LARAMIE COALS *Continued*

Outlying Localities, Horizon not Definite Continued

Localities	Thickness of Seam	Split Volatile ratio	Moisture	Volatile matter	Fixed Carbon	Ash	Sulphur	Calorific Value in B.T.U.	Reference No.
Stream running to Lac la Ronde, reported as	5' 0"	1·76	13·25	28·97	34·76	23·22			14
Sanders river, Swan river, Manitoba, thin seam		1·92	18·82	28·03	49·00	4·15			7
Fort Francis, Rainy river, loose coal		1·86	15·45	33·70	43·45	7·40			16
Moose river, Ont., below Long Portage		1·99	11·74	31·39	44·03	2·84			7

LIST OF INDIVIDUALS AND COMPANIES MINING COAL IN THE PROVINCES OF ALBERTA AND SASKATCHEWAN, DURING 1907.

Note.—Most of this information is compiled from a report issued by the Interior Department, entitled "Report with respect to Coal Lands in the Provinces of Alberta and Saskatchewan, 1907," signed by H. H. Rowatt.

Small operators not included in the above report are obtained from Annual Report of the Department of Public Works of the Province of Alberta, 1906.

ALBERTA.

The total output of coal for 1906 is given as 1,385,000 tons—an increase of seventy per cent over that for 1905—and is divided into the following classes:

Lignite	602,780 tons.
Bituminous	546,623 "
Anthracite	235,547 "
Coal used in coke production	193,636 "
Coke produced	69,814 "

The output for 1907 is reported to be about 1,800,000 tons.

International Coal and Coke Co., of Coleman

Operating at Coleman. Capacity, 1,600 tons per day. One hundred and seventy-six coke ovens. Output, steam coal, sold to Canadian Pacific railway; coke, to smelters of Boundary country.

Operating at Lundbreck. Mine about ready to ship. Domestic coal.

Canadian Amer[illegible] and Coke Co., of Frank.

Operating in tp. 7, ran[illegible] west of 5th meridian. Output, 700 to 800 tons of steam coal p[illegible]sed of to Canadian Pacific railway.

The West Canadian Collieries, Limited, of Blairmore.

Two mines in operation at Lille and Bellevue. Output, 400 tons per day, each. At Lille, Belgian coke ovens are installed. The coal is washed by Lubrig process.

Hillcrest Coal and Coke Company of Hillcrest

Output of mine about 200 tons per day.

The Leitch Collieries, Limited, of Passburg.

Plant for mining being installed on their property, tp. 7, range 3, west of 5th meridian.

Breckenridge and Lund Coal Company, Limited, of Lundbreck

Operating in tp. 7, range 2, west of 5th meridian. Producing about 200 tons per day. Domestic coal.

Western Coal and Oil Consolidated, of Pincher Creek.

Lands situated in tps. 5 and 6, range 2, west of 5th meridian. Prospecting operations being carried on.

Alberta Railway and Irrigation Company, Limited, of Lethbridge

This Company owns 10,000 acres of land in tp. 9, ranges 21 and 22, west of 4th meridian. The output is about 1,200 tons per day, mainly for domestic market.

Diamond Coal Company, Limited, of Lethbridge. (Formerly Bulwell Coal and Iron Mines Company)

Prospecting in tp. 10, range 21, west of 4th meridian, north of Lethbridge; about ready to operate.

Canada West Coal and Coke Co., of Taber.

New plant installed at Taber to increase output to 1,000 tons per day. Present shipments about 250 tons. Domestic coal.

Reliance Coal Mining Co., Limited, Taber.

Operating in tp. 10, range 16, west of 4th meridian. Near Crows Nest Branch, Canadian Pacific railway. Output about 100 tons per day. Domestic coal.

The Consolidated Coal Mining Company, and The Domestic Coal Company, of Taber.

Operating in tp. 10, range 17, west of 4th meridian. Output about 50 tons per day each.

Near *Medicine Hat*, three small coal mines—from seven to ten miles west, on the Saskatchewan—are operated during the winter.

Pacific Coal Company, of Bankhead.

This Company has a lease of 5,600 acres of coal lands in the Rocky Mountain Park, east of Banff. The output is 1,000 tons per day of anthracite, and 300 tons briquets, nut size, made from the fine anthracite.

The Canadian Anthracite Co., of Canmore.

The mine is situated at Canmore, and is operated by the H. W. McNeill

Mining Co. It produces 400 tons of coal per day. The fine coal is washed, and the total output is used by the Canadian Pacific railway.

Messrs. P. Burns and Company, of Calgary

This Company has acquired coal lands on Sheep creek, tps. 18 and 19, ranges 6 and 7, west of the 5th meridian. Prospecting work is being carried on.

Kneehill Coal Company, of Kneehill.

This Company is operating in tp. 29, range 23, west of 4th meridian, producing fifty tons per day during winter. For domestic use.

The Morinville Coal Company, of Morinville

Operating at Morinville, about twenty miles north of Edmonton The output is about 300 tons per day, disposed of to the Canadian Northern railway.

The Alberta Coal Mining Company, Limited, of Edmonton.

This Company is engaged in development work on land in tp. 55, range 25, west of 4th meridian.

Standard Coal Company, Limited, of Edmonton.

This Company's mine is on River Lot No. 22, of Edmonton settlement. Output 100 tons per day, for the domestic market.

The Parkdale Coal Company, of Edmonton,

Producing about forty tons per day at its mine on River Lot No. 24, Edmonton settlement. Domestic coal.

Saskatchewan Coal Company, of Edmonton.

Operating on River Lot No. 28, of the Edmonton settlement. Output about twenty tons per day

The Brenner-Milner Coal Company, of Edmonton,

Producing about thirty tons per day from its mine on Lot No. 42, Edmonton settlement.

Mr. Wm. Humberston, of Edmonton

Operating on River Lot No. 12, Edmonton settlement, and producing about thirty tons per day.

The Strathcona Coal Company, Limited, of Strathcona

Operating on River Lot No. 7, Edmonton settlement, and producing about 100 tons per day, domestic coal

The Edmonton Coal Company, Limited, of Edmonton

Operating on sec. 18, tp. 53, range 23, west of 4th meridian, with an output of fifty tons per day

Messrs. Fraser and Freeman, of Clover Bar.

Operating on sec. 5, tp. 53, R. 23, west of 4th meridian. Their output is about thirty tons per day.

The Milner Coal Company, of Edmonton.

Operating on sec. 7, tp. 53, range 23, west of 4th meridian, and producing about thirty tons per day.

Messrs. Daly and Lindsay, of Clover Bar.

Operating on sec. 7, tp. 53, range 23, west of 4th meridian, and producing about thirty tons per day for the domestic market.

There are many other operators in the Province that are probably not included in the above lists, and from the Public Works report for 1906, the following might be mentioned:

Sturgeon mine, at Namao, operated by C. S. Carnegie.
Big Island mine, at Strathcona, operated by the Wetaskiwin Coal Co.
White Star mine, at Strathcona, by McKenzie and Blain.
Black Diamond mine, at Lineham, by Cooper and McPherson.
Crockford mine, at Medicine Hat, by Crockford Bros.
Galbraith mine, at Cowley, operated by R. J. Galbraith.
Crowfoot mine, at Gleichen, operated by the Blackfoot Indians.
Banner mine, at Namao, operated by Watson Bros.
Threehills, several small operators on Threehills creek.

SASKATCHEWAN.

The total output of the mines in Saskatchewan for the year ending March, 1907, was about 150,000 tons. The largest part came from the mines near the Souris river.

Western Dominion Collieries, Limited, Taylorton.

Operating in tp. 2, range 6, west of 2nd meridian. The output is about 800 tons per day, during winter, and 200 tons during summer.

The Manitoba and Saskatchewan Coal Company, of Estevan

Operating near Bienfait, and newly equipped and ready to handle larger output than the 100 tons per day now being produced

The Eureka Coal and Brick Company, of Estevan

Operating in tp. 2, range 6, west of 2nd meridian. Output about 100 tons per day

The Roche Percee Coal Mining Company, of Roche Percee

Operating in the same vicinity, with an output of about 150 tons per day

Ten other small mines are working in the winter as a rule, in the vicinity of Estevan and the Souris mines, with an estimated output of 200 tons per day, for this period

ANALYSES OF COALS NOT INCLUDED IN MAP.

Below will be found a list of coal analyses for comparison with the coals of the Northwest. These include practically all the Canadian analyses at hand, on the date of compilation, with others selected from United States, and foreign reports.

BRITISH COLUMBIA

Vancouver Island Coals.

	Thickness of Seam	Split Volatile ratio.	Moisture	Volatile combustible.	Fixed Carbon.	Ash.	Sulphur.	Calorific Value in B.T.U.	Reference No.
Comox —									
Union colliery			9·61	16·30	68·25	5·92	0·36	.....	1
Union colliery, No. 5 pit, upper seam.		4·56	1·08	29·24	57·03	9·60	3·05	13261	6
Coal from near Hamilton lake		4·88	1·70	22·82	47·72	27·00	0·76	10626	6
Union colliery, No. 4 slope, Comox seam		5·18	0·88	27·34	61·82	8·70	1·26	13881	6
Union colliery, No. 5 pit, Comox seam		5·11	1·32	27·62	63·64	6·70	0·72	14191	6
Union colliery, No. 6 pit, Comox seam			1·26	27·33	63·49	6·80	1·12	14191	6
Union colliery, Upper seam	4′–4″	.....	1·34	30·01	65·82	2·83	.....	.....	7
Union colliery, Lower seam		.....	1·70	32·36	63·08	2·86	.....	.....	.....
Union colliery, 10 ft. seam, upper part		.....	1·70	27·17	68·27	2·86	.....	.....	7
Trent River seam.	3′–8″	.....	0·92	32·94	58·32	7·82	.....	.....	7
"	3′–8″	.....	0·97	29·95	61·56	5·95	.....	.....	7
Browns River seam	1′–8″	.....	0·95	23·85	70·86	4·34	.....	.....	7
Beaufort mine, slow coking		.....	.....	29·30	55·75	14·95	.....	.....	7
Baynes Sound mine, Richardson seam		.....	1·18	34·13	48·51	16·18	.....	.....	7
Baynes Sound mine, slow coking, upper		.....	29·10		57·48	13·42	.....	.....	7

Baynes Sound mine, slow coking, lower			29·55	64·70	5·75			7
Nanaimo—								
New Vancouver, commercial coal			2·06	34·07	56·94	6·67	0·25	1
Nanaimo colliery			5·35	33·76	46·00	14·32	0·56	3
Nanaimo colliery, No. 1 shaft, esplanade			1·88	33·27	54·67	9·40	0·78 12672	6
Nanaimo colliery, No. 1 shaft, lower seam			2·86	35·84	54·79	5·5	1·01 12951	6
Nanaimo colliery, Harewood mine			1·58	33·84	52·17	11·85	0·56 12238	6
Nanaimo colliery, No. 5, Southfield mine		3·71	2·08	35·78	56·26	5·60	0·28 13261	6
Wellington mine, commercial sample			8·57	25·30	56·40	9·52	0·21	1
Wellington mine			4·14	36·85	46·16	12·85	0·56	3
"		3·29	2·75	38·03	52·64	6·58	12567	7
Extension collieries: Tunnel vein			1·44	31·40	46·18	20·65	0·33 11401	6
" " lower part			1·52	35·27	57·04	5·85	0·32 13416	6
" " top vein			1·24	36·49	53·72	8·20	0·35 13261	6
" " bottom vein			1·28	35·26	55·83	7·30	0·33 13199	6
North End of Island—								
Old H. B. Co. mine, Sukwash, near Fort Rupert			2·84	39·23	46·36	11·57		7
Old H. B. Co. mine, Sukwash, near Fort Rupert			5·03	41·51	46·52	6·94		7
Three-quarter mile south of Kliksiwi River seam	1'–4"		3·65	42·23	39·84	14·28		7
Kink river, near Beaver Harbour seam	0'–6"		3·68	39·29	47·03	10·00		7
Quatsino sound, Koskeemo—								
Koskeemo coal fields	3'–0"		1·05	34·38	54·01	10·56		7

QUEEN CHARLOTTE ISLANDS.

Yakoun river, Masset inlet	18'–0"		2·65	38·19	53·73	5·43		7
Skidegate channel, Cowgitz, Hooper creek			1·99	7·65	80·62	9·74		7
Skidegate channel, Cowgitz, Nicholsons creek			1·60	5·02	83·09	8·76	1·53	7

BRITISH COLUMBIA *Continued.*

QUEEN CHARLOTTE ISLANDS *Continued.*

	Thickness of Seam	Split	Volatile ratio.	Moisture	Volatile combustible.	Fixed Carbon.	Ash.	Sulphur.	Calorific Value in B.T.U	Reference No
Skidegate channel, Cowgitz, Nicholsons creek, 3 ft. seam				1·80	4·77	85·76	6·69	0·89		
Camp Anthracite, Graham island				1·52	8·69	80·07	9·72			
" " "				2·85	7·59	68·25	21·31			
				2·47	35·25	59·36	2·92			
Camp Wilson, Graham island, seam	17′ 0″			1·91	35·24	59·39	3·46			
				1·06	43·48	46·01	9·45			
Camp Robertson, Graham island, seam	6′ 0″			0·80	23·27	51·39	24·54			
				1·33	35·25	48·89	20·85			
Camp Robertson, Graham island, seam	6′ 0″			1·20	29·13	47·52	22·15			

BRITISH COLUMBIA COALS MAINLAND.

Nicola river and vicinity										
Coldwater river, Coal Gully creek, tunnel on lower seam	18′ 6″			3·04	37·18	52·05	7·73			7 and 12
Coldwater river, Coal gully, upper seam	15′ 1″			5·78	27·65	52·69	13·88			
Coldwater river, Coal gully	13′ 6″			3·35	26·55	59·30	10·80			
Coldwater river, Southern outcrop seam	7′ 10″			3·17	35·73	55·25	5·85			
Coldwater river, near Nicola river, upper seam	6′ 0″			2·13	27·99	59·66	10·22			
Junction of Nicola and Coldwater				4·45	33·79	53·05	8·71			
North mouth of Coldwater lower tunnel	7′ 6″			1·37	38·24	54·25	6·14			

Nicola river, near Coldwater, average of 2 slow coking			36·065		61·29	2·64		7
Nicola river from boring on Indian reserve			1·32	29·01	41·47	28·20		14
Quilchena river, lot 1,267	6′ 0″		6·95	37·21	47·95	7·89		7
West side Okanagan lake, B.C., seam	2′ 0″	3·80	1·50	33·95	55·36	9·10		14
Collins gulch, Tulameen river, seam	12′ 0″		4·62	41·16	49·04	5·18		7
" " seam	2′ 6″ and 4′ 8″		4·87	36·86	50·99	7·28		7
" " the large seam			3·26	43·33	49·70	3·71		14
Collins gulch, Tulameen river: seam	15′ 0″ to 25′ 0″		7·87	30·59	51·10	10·44		18
Princeton: seam near town	11′ 4″ and 13′ 4″		11·97	30·49	49·21	8·33		18
" "			16·17	37·58	41·67	4·58		11
Similkameen river, 6 miles south Vermilion Forks			50·13		42·67	7·20		7
Chilliwak river, 5 miles up			35·73		63·88	0·41		7
Hat creek, 1 mile above Marble canyon, Bonaparte River seam	26′ 0″		8·60	35·51	46·84	9·05		7
North Thompson river, 45 miles up			2·22	38·10	46·74	12·92		7
Kohasganko river			9·90	42·61	33·95	13·54		7
Fort Fraser, Nechako river			10·46	41·44	43·21	4·89		7
Skeena river, 9 miles above Forks			1·05	19·09	38·96	40·90		7
Skeena river, 20 miles above Forks			1·52	7·20	16·04	45·24		7
Skeena river, Watsonkwa river, slow				40·52	57·51	1·97		7
Morice river, Skeena river: Seam No 1			4·32	28·86	54·62	12·20		14
Morice river, Skeena river: Seam No 2, top			4·48	25·91	55·57	14·04		14
Morice river, Skeena river: bottom			3·59	28·18	53·94	14·29		14
" "	5′ 6″		1·36	10·87	80·82	6·95		15
" "	7′ 0″		0·80	11·10	78·90	9·20		15
" "	4′ 0″		6·58	10·80	82·70	5·90		15
Tooza river, 16 miles up from Stikine			4·59	33·77	42·67	18·97		7
Goat creek, Telkwa river, Tran continental seam	2′ 4″		0·80	8·20	81·60	9·40		11
Goat creek, Telkwa river, Trans-continental seam	6′ 0″		0·90	9·90	75·80	13·40		11
Goat creek, Telkwa river, lower seam	14′ 0″		0·98	9·94	80·76	8·32		12

BRITISH COLUMBIA COALS—MAINLAND *Continued.*

	Thickness of Seam	Split Volatile ratio.	Moisture	Volatile combustible.	Fixed Carbon.	Ash.	Sulphur.	Calorific Value in B.T.U.	Reference No.
Goat creek, Cassiar Coal Co. area, top seam	7′–7″		1·92	30·45	61·30	6·33			11
Goat creek, middle bench			4·70	30·40	60·80	4·10			11
Goat creek, middle bench, lower part			6·60	29·00	56·90	7·50			19
Hudson Bay mountain, Telkwa river			9·16	5·63	74·70	10·51			14
YUKON.									
Whitehorse Coals									
12 miles S.W. Dugdale station, seam	9′–6″	14·14	2·15	6·01	69·86	21·98			14
" " seam	2′–6″	8·40	3·76	8·34	62·50	25·40			14
" " seam	10′–4″	4·93	3·78	10·06	38·38	47·78			14
" " seam	6′–0″	8·04	2·35	6·65	42·27	48·73			14
" " not named		4·74	3·83	15·84	47·81	32·52			7
12 miles S.W. Dugdale station, average of 2		14·50	2·03	5·64	67·89	24·43			7
Tantalus Butte, (Millers working) opposite Tantalus mine, seam	5′–0″	2·71	9·48	32·28	53·51	4·73			14
Tantalus Butte, (Millers working) opposite Tantalus mine, seam		4·80	0·45	28·74	56·74	14·07			12
Tantalus mine, Lewes river—									
Tantalus mine, top seam	3′–0″	5·87	0·82	25·12	66·03	8·03			14
" middle seam	6′–11″	5·40	0·76	24·74	58·60	15·90			14
" bottom seam	8′–0″	5·33	0·75	23·62	55·21	20·43			14
Five Fingers mine, Lewes River seam	2′–0″	2·65	4·26	40·26	44·67	10·81			14
" " "	2′–6″	2·59	6·42	36·98	46·03	10·57			7
" " "	3′–0″	2·75	6·03	36·92	49·03	8·02			7

Yukon River Coals								
Cliff creek 2½ miles up, upper workings		2·25	8·57	42·04	45·77	3·62		7
Cliff creek, 2½ miles up, lower workings		2·18	10·58	40·10	46·74	2·58		7
Lepine creek, Rock creek, Yukon river		1·90	14·38	34·26	42·80	8·56		7
Coal creek, Rock creek, Yukon river: seam	3′– 0″	1·63	18·31	34·96	40·88	5·85		7
Coal creek, Rock creek, Yukon river: seam lower		1·49	19·37	33·85	37·45	9·33		7
Coal creek, Yukon river: seam	4′ 0″ to 11′– 0″	2·77	6·03	38·44	50·53	5·00		12
Coal creek, Yukon river, 7 miles up	12′– 6″	2·49	7·24	41·45	48·91	2·40		7
Ruby creek, Indian river, Yukon, 7 miles up		3·81	4·68	29·88	60·06	5·38		12

Nova Scotia Coals.

The recent examinations or tests of coal will supersede these old records. Many of these are slow coking and exclude the moisture

Pictou Coals							
Acadia mines, (Albion mines), McGregor seam	32·00		59·30	8·70			7
Acadia mines, (Albion mines), McGregor seam, top bench	22·50		65·70	11·80			7
Acadia mines, (Albion mines), McGregor seam, 2nd bench	23·30		70·00	6·70			7
Acadia mines, Stellar (coal seam)	33·58		62·09	4·33			7
" " (stellarite)	66·56		25·23	8·21			7
" " (shale)	30·65		10·88	58·47			7
" Acadia seam, slow	2·10	32·27	57·57	7·55	0·56		24
" " "	2·40	29·20	61·45	7·55	1·48		24
Foord pits; main seam	1·73	28·18	62·94	7·15	0·32		24
" "	1·48	24·28	66·50	7·74	0·55		24
Albion mines: Deep seam, slow coking	1·29	25·44	61·65	10·25	0·86		24
" "	0·75	20·34	68·50	10·41	0·94		24
Crown Pottery pit: Richardson seam	0·76	38·84	55·81	5·09			24
Old Fraser mine, Foster seam	29·00		53·14	17·60			24

NOVA SCOTIA COALS—*Continued.*

	Thickness of Seam	Split	Volatile ratio.	Moisture	Volatile combustible	Fixed Carbon	Ash	Sulphur	Calorific Value in B.T.U.	Reference No.
Lawsons slope, Lawson seam				2.5 10		50 00	24 60			
Marsh colliery, Geo. Mackay seam				29 85		62 22	7 93			
McBeans slope, McBean seam, 1st bench				1 57	29 29	52 36	16 76			
McBeans slope, McBean seam, 2nd bench				2 67	28 65	49 66	19 42			
McBeans slope, McBean seam, 3rd bench				1 67	27 20	54 86	15 27			
Montreal and Pictou mines, 1st bench, slow coking				1 90	23 95	57 17	16 94			
Montreal and Pictou mines, 2nd bench, slow coking				2 22	30 23	58 70	7 85			
Nova Scotia colliery, Acadia seam, top				3 00	29 61	59 51	7 88			
Nova Scotia colliery, Acadia seam, middle				4 40	24 95	61 07	9 58			
Nova Scotia colliery, Acadia seam, bottom				5 47	19 30	68 55	6 05			
Drummond colliery, Acadia seam, top coal, fast coking					32 68	62 08	5 24			
Drummond colliery, Acadia seam, Fall coal					32 39	62 40	5 21			
Drummond colliery, Acadia seam, 1st bench					33 45	61 41	5 14			
Drummond colliery, Acadia seam, 2nd bench				0 72	29 21	60 35	9 46	0 26		
Drummond colliery, Acadia seam, 3rd bench				1 56	30 13	60 32	7 56	0 42		
Drummond colliery, Acadia seam				1 80	31 72	55 39	10 50	0 54		
				1 31	28 66	60 31	8 67	1 04		
				1 43	29 32	59 89	8 79	0 56		
				1 52	29 46	60 19	9 10	1 62		24

Springhill Coals –							
Black mine, main seam (West slope No. 2)		1·21	33·08	61·49	4·22	0·25	[illegible]
Black mine, main seam		0·98	35·52	59·42	4·08		
Styles mine		1·05	38·18	51·37	6·40		
Styles mine		3·72	37·73	47·73	10·89		
Black river, Cumberland co.		3·75	34·33	47·96	13·98		
Inverness mines, (Broad Cove mines) Inverness co.: seam	5′ 9″	7·78	34·51	46·03	11·68	.	7
Inverness mines, (Broad Cove mines) Inverness co.: seam	7′ 0″	4·02	25·39	65·49	5·10	.	7
Inverness mines, (Broad Cove mines) Inverness co.: seam	3′ 0″	7·92	34·71	46·60	10·77		7
Inverness mines, (Broad Cove mines) Inverness co.: seam	3′ 0″	8·49	36·82	48·40	6·29	.	7
Inverness mines, (Broad Cove mines) Inverness co.: seam	3′ 9″	8·45	36·52	48·78	6·25	.	7
Port Hood mines, Inverness co., 150 ft. on slope		4·02	38·81	49·65	7·52		7
Port Hood mines, Inverness co., 1150 ft. down slope, face of slope		2·11	38·86	49·25	9·78		
Port Hood mines, Inverness co., south level		2·47	38·48	50·39	8·66		7
Port Hood mines, Inverness co. north level		2·42	37·48	50·96	9·14		7
Mabou coal mines		5·29	41·87	50·08	2·76		14
Sydney Coals							
Gowrie seam		0·50	28·13	66·10	5·36	1·75	24
Hub seam, L. Glace Bay mines, slow coking	7′ 6″		30·54	62·53	6·93		7
Hub seam, L. Glace Bay mines, slow coking			28·62	65·85	3·24	2·29	7
Block House seam, Block House mine, slow coking	8′ 10″		38·80	55·80	5·40		7
Block House seam, Block House mine slow coking			31·90	62·79	5·27	1·76	7
Harbour seam, International mine slow coking	6′ 1″		38·50	56·50	5·00		7
Harbour seam, International mine, slow coking			31·09	62·92	2·99	2·26	7

NOVA SCOTIA COALS—*Continued.*

	Thickness of Seam	Split Volatile ratio.	Moisture	Volatile combustible	Fixed Carbon	Ash.	Sulphur	Calorific Value in B.T.U	Reference No
Harbour seam, Lit. Glace Bay mine, slow coking	5′–0″	.....	30·21		67·78	2·01	0·90		7
Victoria seam, Victoria mine, slow coking	6′–7″	.....	38·70		58·40	2·96			7
Sydney Main seam, Sydney mine, slow coking	6′–0″	.....	26·94		65·57	5·49			7
Sydney Main seam, Sydney mine, slow coking			31·87		64·59	3·54			7
Sydney Main seam, Sydney mine, slow coking			34·18		61·50	4·32	1·24		7
Sydney Main seam, Sydney mine, slow coking			32·74		61·54	5·72			7
Sydney Main seam, Sydney mine, slow coking			1·53	36·36	57·01	5·08	1·89		24
McAuley seam, Gowrie mines, slow coking	4′–11″	.....	36·15		58·07	5·70			7
McAuley seam, Gowrie mines, slow coking			32·07		64·43	3·50	2·86		7
Phelan seam, Caledonia mine, slow coking	8′–0″	.....	37·26		58·39	4·35			7
Phelan seam, Caledonia mine, slow coking			35·47		61·67	2·86	2·06		7
Phelan seam, Reserve mine			1·00	36·26	58·39	4·35	2·47		7
" "			34·50		59·50	6·00			3
" "			4·93	30·13	59·52	4·26	1·16		7
" Bridgeport mine, slow coking			33·20		61·39	5·41			7
Phelan seam, Clyde mine, slow coking	8′–6″		33·00		57·37	9·63			7
" "			32·82		64·33	2·85	2·17		24
Phelan seam			0·52	34·21	59·73	3·92	0·81		24

International seam		0·80	27·55	65·90	4·30	1·45	24
Emery seam		0·64	31·10	63·10	3·65	1·51	24
Lingan Main seam, Lingan mine, slow coking			30·05	66·91	3·06		7
Ross seam, Schooner Pond mine, slow coking	5′–8″		34·23	63·98	1·79	0·77	7
Ross seam, Schooner Pond mine, slow coking	6′–11″		38·10	58·45	3·45		7
Collins seam, Little Bras d'Or mine, slow coking			31·75	66·85	1·40	1·21	7
Gardiner seam, Gardiner mine, slow coking	5′–0″	1·63	35·12	59·19	6·06		7
Gardiner seam, Gardiner mine	4′–8″		34·33	61·97	3·70		7
Lorway seam, Reserve mine, slow coking			31·96	65·22	2·82	1·18	7
Tracey seam, Tracey mine	4′–0″		24·47	55·98	13·28	6·27	7
Fraser seam, Sydney harbour, slow coking		2·23	30·09	66·61	0·98		7
Carroll seam, Bridgeport basin, slow coking			31·40	62·40	6·20		7
Indian Cove seam	4′–0″		32·80	61·40	5·80		7
		1·82	34·94	56·97	6·27		7

Various Outlying Occurrences.

Hants co.: Small seam in the Gore		1·90	23·90	49·40	24·80		11
Cariboo cove, from 200 ft. level		0·98	25·68	52·10	21·24		14
Little river, Inhabitants basin, slow coking			30·25	56·40	13·35		7
Caribacou: Near Inhabitants basin, slow coking			25·20	44·70	30·10		7
Big pond, East bay, slow coking			41·79	44·98	13·23		7

NEW BRUNSWICK.

Little Lepreau		1·27	5·81	56·04	36·88		7

Welsh Coals.

	Thickness of Seam	Split Volatile ratio	Moisture	Volatile combustible	Fixed Carbon	Ash.	Sulphur	Calorific Value in B.T.U.	Reference No.
Glen Neath			3·39	14·25	78·74	3·62	0·121		3
Albion Cardiff			2·79	14·91	69·92	12·38	0·777		3
Castle Gate			3·35	38·65	48·63	9·36	0·200		1
Albion Methyr			2·64	19·94	71·26	4·83	1·316		1
Albion Methyr			3·19	15·09	68·11	13·51	0·499		1
Albion Cardiff			2·81	8·646	85·16	3·24	0·138		3
Bryn Blaen			1·95	7·40	84·60	6·05	0·198		3
New Zealand: Westport coal			2·65	34·93	61·80	0·20	0·42		3
Australia: Duckenfield coal			4·05	29·22	58·68	8·05	0·27		3
Australia: N.S.W., Hetton, Bullock island			3·17	32·09	60·04	3·80	0·17		3
Australia: N.S.W., Wallsend, Newcastle			4·70	28·73	60·39	6·00	0·17		3
Australia: N.S.W., Wallsend, Newcastle			7·16	23·28	56·01	13·16	0·38		3

UNITED STATES COALS.

In the St. Louis tests fresh coal from car lots was examined and the loss on air drying has been put in second column. The Navy trials separated non-combustible gas from moisture; in these tables it has been added to moisture.

	Thickness of Seam	Loss on air drying	Moisture	Volatile combustibles	Fixed Carbon	Ash	Sulphur	Calorific Value in B.T.U.
Alaska Coals. *								
Matanuska Coal								
Coal creek, ¼ mile above Matanuska river. Seam	5′-0″	0.80	2.21	23.08	70.21	4.47	0.50	
Tsadaka creek, 1½ miles above trail. Seam	11′ 8″	1.60	10.05	36.05	18.90	5.00	0.25	
Tsadaka creek, 4 miles above trail. Seam	6′ 0″		4.03	34.84	49.31	11.82	0.58	
Matanuska river, 3 miles above Chickaloon creek	7′ 0″	1.60	4.36	18.02	61.19	15.73	0.57	
Chickaloon creek, Watsons tunnel No. 3	7′ 0″	1.00	2.46	17.01	53.23	27.30	0.84	
Chickaloon creek, Watsons tunnel No. 2	12′ 3″	1.60	2.58	19.14	67.46	10.82	0.[illegible]7	
King creek, upper beds	9′ 10″	1.80	2.95	21.85	[illegible]	12.[illegible]	0.[illegible]	
Coal creek, [illegible] miles above Matanuska river	8′ 7″	1.10	6.70	14.96	65.8[illegible]	12.47	[illegible]11	11968
Chickaloon creek, Watsons tunnel No. 5	7′ 10″	1.90	2.90	37.47	56.1[illegible]	2.48	0.[illegible]	
Matanuska valley between [illegible] and Hicks creek	8′ 0″		2.55	7.08	84.[illegible]2	6.1[illegible]	0.[illegible]	1571[illegible]
[illegible]ska creek, 3 miles above trail	3′ 3″		6.60	34.50	48.25	10.87	0.4[illegible]	12[illegible]4[illegible]

*Analysis as given in U. S. Geol. Survey Bull. No. 289.

UNITED STATES COALS—*Continued*

	Thickness of seam	Loss on air drying	Moisture	Volatile combustible	Fixed Carbon	Ash	Sulphur	Calorific Value in B.T.U.	Reference No.
Chickaloon creek, Watsons tunnel, No. 2	5'-2"	.....	0·90	19·60	74	4·90	0·60	14885	
Bering River Coals—									
Lower end of Gorge, Tokun creek	6'-8"	3·70	4·35	11·97	7 .4	10·34	1·13	.....	.....
Christopher's opening, branch of Dick creek	0	5·20	6·03	12·98	75 40	2·59	0·70		
Christopher's lower tunnel, Dick creek	7'	5·19	5·84	11·74	60 21	22 21	3·36		
Queen creek, opening on lower seam	11' 0	4·60	5·66	13·65	76 81	3 88	0·77		
Queen creek, opening on upper seam	27' 0"	3·00	4·23	14·03	29 73	1·99	0·96		
Carbon Creek tunnel	11' 0"	3·70	4·22	13·37	78 80	3 [illegible]	1·56		
Carbon Creek tunnel, near mouth of South branch Queen creek	19 [illegible]	5·40	5·95	13·01	76 12	4 [illegible]	0·01		
	17' 0"	3·90	4·94	13·34	77 29	4·13	0·83		
Kushtaka river, tunnel, 710 ft. above lake	18'-0"	1·90	2·68	11·06	73·31	12·95	5·27	...	...
Cunninghams upper tunnel, Trout creek	8'-0"	1·30	2·11	16·58	79·68	1·63	0·78	.....	.....
North end of Hunts hillside trail, Carbon mountain	15'-0"	5·20	5·93	6·76	81·47	5·84	0·82	.....	.....
Lower seam east side Carbon mountain	4'-8"	6·20	7·26	6·64	75·89	10·21	1·27		
Head of First Berg lake, Carbon mountain	2'-2"	1·90	3·74	5·41	85·92	4·93	1·10		
Head of Fourth Berg lake, Carbon mountain	2'-8"	4·70	7·67	5·78	66 03	20 52	2·80		
Carbon mountain, west side of crest	2'-9"	1·50	4·43	10 14	80 78	4 65	0·51	13540	
Eastern opening hill-side trail, Carbon mountain	15' 0"	6 10	8 33	6 36	82 00	3·31	1·11		
Carbon mountain, west side of crest nearer summit	5'-3"	5 00	7 94	9·20	78 53	4 33	0 79		...

Carbon mountain, south end Hillside trail, west side	10' 0"	7.00	8.3[illegible]	7.12	82.43	2.14	1.05		
Carbon mountain, west opening, east side of hill	10' 6"	13.20	13.84	5.01	73.87	7.23	0.82	12137	
Trout Creek tunnel, ¼ mile below house	33' 0"	5.40	6.34	14.29	69.55	9.82	0.64		
Alabama Coals									
Horsecreek, Ivy C. & T. Co. mine No. 8	8' 0"	0.80	1.55	32.10	53.71	12.64	0.73	12858	4
Carbon hill, Chickasaw mine No. 5	4' 5½"	0.80	2.58	33.15	51.74	12.53	1.02	12440	4
Adger, Adger mine, Blue Creek bed	10'-10	6.80	1.10	26.15	62.08	10.57	0.96		4
Johns, Johns mine, Blue Creek bed	7' 6½"	1.70	0.95	26.95	60.66	11.44	0.90		4
" "	7' 6½"	2.80	0.50	26.51	62.97	9.93	0.96	1404[illegible]	4
Kellerman, Central mine, Brockwood bed	7' 2½"	2.80	1.04	31.06	57.61	10.29	1.53		4
Brockwood, Slope No. 7, Milldale bed	2' 2"	1.50	0.47	32.03	61.89	5.61	1.12	13582	4
Brockwood, Drift No. 10, Carter bed	3' 0"	3.40	0.47	31.88	61.80	5.85	0.80		4
Belle Sumpter, Blue Creek bed		1.50	0.71	24.00	61.44	12.86	0.55		4
" "		3.70	0.79	23.16	40.83	26.22	1.57		4
Searles, Brockwood bed		1.40	1.06	32.79	58.92	7.23	1.30		4
Tidewater, Brockwood bed		0.80	1.29	34.96	52.10	11.65	1.58		4
Jefferson co., Pearson Warrior coal			4.83	18.95	72.76	3.28	0.17		1
"			2.35	23.96	72.03	1.26	0.[illegible]		1
Blocton, Bibb Co., Cahaba coal			4.16	24.94	67.43	3.27	0.19		1
" "			3.22	25.70	64.33	6.70	0.05		1
Corona, Walker co., Corona coal			2.45	31.21	55.55	9.61	1.76		1
" "			3.04	30.93	59.17	6.09	0.77		1
Coal Valley, Walker co.			4.41	28.07	58.08	8.22	1.22		1
"			3.98	31.22	55.75	6.66	2.40		1
Cordova, Shaw coal			2.83	24.19	70.31	2.74	0.42		1
Millsdale, Tuscaloosa co.			1.28	27.43	69.23	1.77	0.28		1
Jefferson co., Pratt coal			1.89	26.27	69.52	2.32	0.19		1
"			2.50	25.77	68.[illegible]	3.70	0.[illegible]		1
Altoona, Marshall co.			1.99	34.85	48.94	14.27	0.67		1
Gamble			2.78	24.65	61.96	[illegible]	[illegible]		
[illegible] Coals									
Huntington, Central Coal Co., Mine No. [illegible]	7' 7"	2.10	1.17	17.8[illegible]	68.12	12.88	1.27	[illegible]	4
Bonanza, [illegible] Coal, Mine No. 12	5' 8"	1.50	0.74	16.26	[illegible]	[illegible]	1.80	[illegible]	4

UNITED STATES COALS—*Continued.*

	Thickness of Seam.	Loss on air drying	Moisture	Volatile combustible	Fixed Carbon.	Ash.	Sulphur	Calorific Value in B.T.U.	Reference No.
Jenny Lind, Western Coal Co., Mine 18	4′-8″	0·10	3·08	18·62	66·10	12 20	1·70	13477	4
Jenny Lind, Western Coal Co., Mine 18		3·00	0 82	14 32	70 62	14 24	1 30		4
Coalhill Western Co. Mine No 4		1·10	1 28	12 82	73 69	12 21	2 01	13406	4
Jenny Lind, Huntingdon coal bed	6′ 0″		0 95	17 91	71 52	9·62	2 07	14096	4
" " "			0 80	17·20	74 35	7 65	1 64		4
" " "	3′-7″		0 85	14 45	76 41	7 29	2 05		4
" " "	4′ 3″		0 84	16 46	75 32	7·38	1·91	14045	4
Midland City Huntingdon bed	2′-10″		0 97	19 68	69 62	9 73	1 11	13022	4
" " "	12′-9″		1·00	16·90	71·80	10 30	0 60		4
" " "	7′ 7″		0 80	17 80	72·71	8 69	1 95	14281	4
Burma, Huntingdon bed			1·88	14·10	80·61	3 41	0·36		3
Bonanza Sebastian co									
California Coal									
Tesla, Alameda co. Tesla mine		4·50	18·02	39 22	26 39	16 37	3·07	8105	5
Colorado Coal									
Lafayette, Simpson mine	11′-0″ to 14′-0″	6·00	13·49	37·11	43 03	6 37	0 58	10791	4
Canyon city			6·72	34·76	52 70	5 82			7
Erie and Canfield, mines near			14·80	34·50	47·30	3·40			7
Georgia Coal									
Lookout mountain, Durham coal			2 24	14·59	80 07	2 92	0 17		1
Illinois Coal									
Benton Benton mine		4·60	8·31	31 65	49 56	10 48	1 55	11727	5
Bush. Bush No 1 mine		3·60	8·20	32·26	46·59	12 95	3 48	11362	5
Bush commercial sample		5·48	36·22	47 70	10 60	3·70	1·2262		4
Carterville Big Muddy Coal Co		5·80	8 86	31·25	48 23	11·66	2·46		5
Centralia Pettinger and Davis mine		4·20	9 95	34·76	42 06	13·23	3·87	10960	5
Coffeen. Clover Leaf Shaft No. 1		9 80	5·13	32·68	47·46	14·73	4·45	11158	4

Coffeen. Clover Leaf Shaft No. 1, mine sample	8·10	11·93	29·99	43·90	14·18	4·29	10303	5
Collinsville. Dunk Bros. C. & C. Co. slack-washed	12·50	5·16	34·98	40·67	19·19	3·76	10651	4
Collinsville. Lumaghi C. Co. Mine No. 2	3·50	10·86	36·24	39·75	13·18	4·53	10816	5
Herron. Mine No. 7, Williamson co.	4·00	8·43	30·08	51·89	9·60	1·14	11959	5
La Salle. La Salle shaft	8·40	12·39	36·89	41·80	8·92	3·92	11399	5
Marion. Mine No. 3, run of mine	2·70	5·96	30·29	52·16	11·59	1·77	12103	4
Troy. Dunk Bros. C. Co. No. 3 mine	1·70	11·40	32·45	44·30	11·85	1·34	10991	4
O'Fallon. W. A. Coal Co. Mine No. 1	3·70	6·28	38·92	41·08	13·72	4·25	[illegible]	4
Paisley. Paisley mine	4·40	13·20	34·33	39·94	12·53	4·47	10514	5
Springfield. Capital Coal Co. No. 2 mine	8·00	12·77	34·68	40·77	11·78	4·16	10757	5
Zeigler. Franklin co.	5·60	10·72	29·86	50·06	9·36	0·91	11686	5
Staunton. Macoupin co.	9·00	13·54	35·69	40·03	10·74	4·03	10807	5
West Frankfort. Franklin co.	6·90	9·50	31·98	47·08	11·44	1·45	11506	5
Indiana Coal								
Boonville. Electric mine	3·60	6·24	37·49	42·76	13·51	4·60	11538	4
Boonville. Wooley Coal Co., mine No. 3	8·50	13·18	31·92	39·27	15·63	4·79	10030	5
Dugger. Island Coal Co., mine No. 1	4·00	12·15	33·48	46·23	8·14	1·41	11761	5
Hymera. Consolidated Indiana Co. Mine 33	7·20	12·03	35·65	44·44	10·88	4·27	11192	5
Hymera. Consolidated Indiana Co. Mine 34	5·20	10·80	36·09	40·49	12·62	4·39	11185	5
Macksville. Red Bird mine	8·00	12·82	34·80	42·08	10·30	3·27	11119	5
Mildred. Mildred mine	3·00	8·66	34·86	42·67	13·81	2·58	11405	4
Littles. Littles mine	3·60	8·90	38·52	43·37	9·21	3·74	12008	5
Rosedale. Park Coal Co.	8·10	10·72	39·29	41·42	8·57	3·83	11767	5
Star City. Consolidated Indiana Coal Co. No. 29	10·80	13·99	29·40	42·29	14·32	2·31	10318	5
Terre Haute. Deep vein mine	4·60	9·55	36·19	43·65	10·61	3·72	11759	5
Indian Territory Coals								
Alderson		3·28	32·38	57·34	7·00	0·20		
Hartshorne. Mine No. 8	2·80	1·70	37·19	49·79	11·32	1·56	12669	4
Henryetta. Mine No. 1	3·30	3·87	35·73	50·05	10·35	1·99	12620	4
Edward. Edwards Mine No. 1	1·20	3·45	37·45	47·82	11·28	3·67	12169	4

UNITED STATES COALS.—*Continued.*

	Thickness of Seam.	Loss on air drying.	Moisture	Volatile combustible	Fixed Carbon.	Ash.	Sulphur.	Calorific Value in B.T.U.	Reference No.
Lehigh. Mine No. 7, Western C. & M. Co.		2·70	5·74	31·46	37·05	25·75	4·06	9362	4
Lehigh. Mine No. 5, Western C. & M. Co.		1·40	4·91	37·79	43·90	13·40	4·02	11389	4
Iowa Coal—									
Altoona. Gibson C. Co., Mine No. 4		3·80	4·52	40·96	38·99	15·53	6·83	11356	4
Avery. Smoky Hollow Coal Co. Mine No. 6.		6·60	5·81	43·49	40·65	10·05	5·41		4
Avery. Smoky Hollow Coal Co. Mine No. 6.		10·40	6·07	41·18	42·28	10·47	5·22	12114	4
Hamilton: Mammoth vein, C. Co. Mine 6.		10·40	4·25	37·02	41·74	16·99	5·20	11182	4
Laddsdale. Anchor C. Co. Mine No. 2.		3·20	5·21	31·76	46·51	16·52	5·20	11392	4
Kansas Coal—									
Atchison. Atchison mine.		3·50	3·57	37·00	46·80	12·63	8·33	12337	4
Fleming. Mine No. 10.		1·30	3·74	33·11	50·01	13·14	4·34	12404	4
Scammon. Mine No. 9 as received			2·50	33·80	51·25	12·45	5·68	12000	4
West mineral. Southwestern Development Co. No. 11		2·30	1·84	32·40	54·97	10·79	3·86	13199	4
West mineral. Southwestern Development Co. No. 11		2·30	4·10	31·65	53·71	10·54	3·77	12895	5
Yale. Western C. & M. Co. Mine No. 11		2·00	2·23	31·87	47·63	18·27	6·40	11880	4
Kentucky Coals—									
Central city. Central mine.		3·00	8·47	35·24	46·81	9·48	3·60	11986	5
Earlington. Mine No. 11.		2·70	5·36	38·99	46·27	9·38	3·72	12539	4
Earlington. Barnsley mine.		2·20	5·85	36·90	46·96	10·29	3·60	12292	4
Jellico coal.			4·40	31·56	61·87	1·86	0·314		1
Kensee. Main Jellico Mt. Coal. Co.		2·60	2·48	37·04	55·93	4·55	0·91	13972	4

Laurel county			4·64	31·50	61·00	2·86	1·12		3
Manchester (Altamount)			4·08	35·50	58·16	2·26	0·461		3
Pikesville coal			1·82	42·11	36·53	19·54	2·58		3
Pinesville coal			3·25	33·59	62·07	1·09	0·129		3
Providence coal			5·90	30·60	56·74	6·76	0·807		3
Straight creek. Straight Creek mine No. 2	1·20	1·92	5·56	57·08	1·44	1·24		14319	4
Straight creek Straight Creek mine No. 2	3·70	5·21	33·47	53·10	8·22	1·12		13214	5
Wheateroft. Wheateroft shaft mine	2·80	2·54	36·08	46·79	14·59	4·67		12294	4
Maryland Coal									
Big vein, Cumberland Alleghany co		1·69	16·11	74·87	7·32	0·14			3
Georges creek. Alleghar co		1·84	11·07	81·95	5·06	0·07			2
" "		2·00	14·85	78·33	4·57	0·24			2
" "		1·83	12·85	78·08	6·83	0·50			2
Westport, Washington No. 3 mine	1·46	2·33	16·11	68·43	13·13	1·49		13255	5
Michigan Coals									
Bay co. Upper Verne coal, Winona mine		2·06	41·40	51·89	4·65				10
Bay co. Upper Verne coal, Old Monitor mine		10·03	35·36	49·94	4·67	1·12			10
Bay co. Upper Verne coal, Valley mine		1·70	35·50	53·30	9·50				10
Bay co. Upper Verne coal, Central Coal Co		4·32	40·57	42·16	12·75				10
Bay co. Lower Verne Michigan C & M. Co.		5·01	39·62	41·67	13·70	6·66			10
Bay co. Lalzburg mine		6·50	43·61	47·82	2·07	0·89			20
Bay co. Wolverine No. 2 (Verne coal)		6·76	42·67	42·01	8·65	3·50		12295	20
Bay co. Wolverine No. 2 (Verne coal		6·18	46·10	40·88	6·84	2·27		13335	20
Bay co. Wolverine No. 2 (Verne coal)		4·14	45·70	42·14	8·02	3·53		12520	20
Missouri Coals									
Barnet Morgan Co Coal Co	7·70	5·39	44·91	44·47	5·23	5·55		13529	4
Bevier Northwestern C. & M. Co Mine No. 8	2·60	9·14	34·53	39·02	17·31	5·30		10451	4
Lexington Summit mine	11·08		35·85	39·77	13·30	2·86		10957	4
Mendota Mendota coking lack coal	10·80	5·51	32·08	39·11	23·30	4·13		9911	4
Sprague. New Home mine No. 1.	5·00	3·50	35·35	30·77	20·38	5·53		11114	4

UNITED STATES COALS *Continued*

	Thickness of Seam.	Loss on air drying.	Moisture	Volatile combustible	Fixed Carbon	Ash.	Sulphur	Calorific Value in B.T.U.	Reference No.
Montana Coals									
Red Lodge. Northwestern Improvement Co.		2·20	9·05	36·70	43·03	11·22	1·76	10777	4
New Mexico Coals									
Albuquerque Brook's mine			6·55	25·75	41·28	23·42	0·45		4
Algodones Sloan's mine			9·68	42·32	41·36	6·64	0·66		4
Algodones. Hagen mine. Hopewell bed			7·81	44·72	41·80	5·67	0·69		4
Gallup Otero mine slack coal		2·90	8·43	34·82	37·83	19·22	1·30	10202	4
Gallup. Weaver mine. American fuel Co.		1·60	10·86	35·44	45·90	7·40	0·61	11455	4
North Dakota									
Lehigh Lehigh mine, Stark co.		23·60	15·42	38·73	33·61	12·24	2·02	9064	4
Williston Williston mine		24·10	16·70	37·10	39·49	6·71	0·65	9491	4
Wilton. McLean co		12·70	35·96	31·92	24·37	7·75	1·45	7069	5
Near Turtle mountain			13·98	40·81	36·90	8·31			5
Oregon									
Beaver Hill			11·48	33·16	54·99	2·82	0·54		2
Ohio—									
Bradley. Jefferson co. Crow Hollow mine		1·40	3·53	37·45	49·90	9·12	3·47	13072	5
Brilliant, Jefferson co Pittsburgh coal bed		2·90	2·44	35·91	50·63	11·02	3·16		4
Clarion. Vinton co. Clarion mine		3·20	5·59	36·86	49·26	8·29	3·15	12773	5
Dixie. Perry co Dixie mine		4·50	7·55	38·00	46·08	8·37	2·84	12128	5
Danford Guernsey. Forsythe mine		2·60	6·65	33·94	48·86	10·55	3·13	12179	5
Neffs Belmont co. Mine No. 1		3·90	5·31	36·72	49·45	8·52	3·33	12843	5
Rush run, Jefferson co. Rush Run mine No 1		2·40	4·34	35·53	52·83	7·30	1·72	13178	5

Shawnee, Perry co. Goslin and Barbour mine	3·90	9·90	33·66	14·86	11·58	1·81	11277	5
Wellston, Jackson co, Superior Coal Co. Mine No 10	3·60	9·01	35·85	43·80	11·34	4·02	11495	5
Wellston, Jackson co., Superior Coal Co. Mine No. 10	4·90	7·71	8·32	42·02	11·95	4·61	11515	5
Island creek, Jefferson co, Finley coal bed	1·90	2·03	37·17	53·26	7·54	3·70		4
New Alexandra, Jefferson co., Pittsburgh coal bed	2·80	2·46	35·69	52·13	9·72	2·45		4
Georges run, Jefferson co., Pittsburgh coal beds	3·80	2·86	35·84	52·35	8·95	2·62		4
Pennsylvania Coals								
Anderson. Pittsburgh bed		1·70	37·20	55·83	5·27	1·13	14335	4
Average of 30 anthracite car loads		3·30	3·80	84·00	8·40	0·50		21
Argyle mine. Cambria county.		4·33	10·68	80·49	4·07	0·42		3
" "		2·71	11·11	79·97	5·06	0·83		3
" "		1·50	15·28	78·19	4·75	0·28		3
Ames bed. Bigger creek. Murdockville		2·15	39·15	52·65	6·05	3·64		4
Beallsville. Waynesburg bed	1·40	1·18	33·62	48·01	17·19	2·27		4
Berlin. Platt coal bed		1·00	18·17	53·52	21·92	5·38		9
" "		0·87	20·33	68·94	8·68	1·76		9
Berlin coal bed. Berlin, Somerset co		1·94	21·53	68·55	6·40	1·16		9
" "		2·01	20·53	68·32	8·39	0·74		9
" "		1·62	22·76	67·46	7·34	0·80		9
Bertha mine, Bruce	1·50	2·61	34·92	56·30	6·17	1·26	13997	5
Bernice coal area. Bed B.		1·29	8·10	83·31	6·23	1·03		12
Big Bend. Twin rocks		1·35	15·98	75·01	6·66	1·00		3
Cameron Colliery, Northumberland co, lump		1·81	6·18	86·74	1·50	0·75		9
Cameron Colliery, Northumberland co, slack		2·28	6·62	75·72	11·18	1·19		9
Cameron Colliery, Northumberland co, slack		3·17	6·84	76·63	11·99	1·35		9
Carmichaels. Waynesburg bed		1·03	38·30	48·06	8·94	2·72		9
Clinton. Pittsburgh bed		3·55	35·55	47·55	13·55	1·41		4
Durban Waynesburg bed	1·20	1·61	36·19	48·93	12·97	3·51		4
Elkenfield, Cambria co	2·90	3·51	16·82	73·04	6·63	0·94	14279	5
Ellsworth Coll No 2. Pittsburgh bed		1·05	36·65	57·25	5·05	0·91		4

United States Coals.—*Continued.*

	Thickness of Seam.	Loss on air drying.	Moisture	Volatile combustible	Fixed Carbon.	Ash.	Sulphur.	Calorific Value in B.T.U.	Reference No.
Ellsworth Coll. No. 1. Pittsburgh bed			1·22	36·28	56·24	6·26	0·84		4
Ellsworth Nos. 1 and 2. Pittsburgh bed		1·00	2·46	34·48	57·01	6·05	0·88	14013	5
Eureka. Clearfield co.			2·03	20·05	71·63	4·32	1·96		2
Eureka No. 22. Clearfield co.			1·64	19·41	74·43	4·39	0·13		1
" "			1·11	14·28	80·32	4·00	0·29		1
East Millsboro. Hustead-Seamens mine		2·40	3·46	31·80	51·74	13·00	1·95		5
" "		2·00	3·24	31·78	52·46	12·52	1·94	12879	5
Elk Lick. Jenner Cross roads			0·89	20·52	65·90	11·54	1·14		2
Frankfort. Pittsburgh bed			2·51	35·49	50·15	11·85	3·24		4
Freeport, upper coal bed, Hookston			1·50	39·87	46·96	7·07	4·59		2
" " "			1·37	37·80	54·46	4·78	1·58		2
" " "			2·08	39·52	54·69	2·46	1·24		2
Freeport, upper coal bed near Homer			0·59	28·71	52·48	12·75	5·46		2
" " "			0·70	29·68	63·76	4·13	1·71		2
" " "			0·80	25·77	70·22	2·58	0·62		2
" " Salina stat			1·06	33·95	54·39	9·53	1·05		2
" " Somerset			0·86	16·88	66·05	15·61	0·58		2
Gazzan. Clearfield co.			2·13	20·28	70·62	6·69	0·28		1
Greensburg. Jamison mine		2·20	3·15	30·27	56·17	10·41	1·26	13406	5
Gallitzin coal bed, Wurtemburg			1·94	39·26	55·82	2·24	0·72		2
Hackett. Redstone bed			1·46	35·56	53·39	9·59	2·05		4
Hackett. Pittsburgh bed			1·72	36·98	56·55	4·75	1·15		4
Homer. Freeport upper bed			0·59	28·71	52·48	12·75	5·46		2
Hookston. Freeport upper bed			1·50	39·87	46·96	7·07	4·59		2
Houtzdale. Mount Vernon coal			2·04	17·40	74·20	5·65	0·71		3
Hustead-Seamens mine. E Millsboro		2·40	3·46	31·80	51·74	13·00	1·95		5

Hustead-Seamens mine. F Millsboro	2·00	3·24	31·78	52·46	12·52	1·94	12879	5
Jamison mine	2·20	3·15	30·27	56·17	10·41	1·26	13406	5
Jenner Cross roads, Elk Lick coal		0·89	20·52	65·90	11·54	1·14		9
Jefferson. Green co. Waynesburg bed								
Kimmelton. Kimmelton mine	2·60	3·09	17·29	68·29	11·33	2·04	13424	5
Lackawana		3·13	6·79	81·71	8·01	0·35		2
Lehigh coal-market sizes. Egg		1·72	3·51	88·49	5·66	0·60		21
" " Stove		1·42	4·15	83·67	10·17	0·57		21
" " Nut		1·73	4·04	80·71	12·66	0·84		21
" " Pea		1·70	3·89	79·04	14·64	0·69		21
" " Buckwheat		1·69	4·05	76·91	16·62	0·71		21
Ligonier. Ligonier mine	3·20	4·09	20·62	62·82	12·47	2·08	13153	5
London, S.H. Pittsburgh bed		2·48	38·74	49·18	9·60	1·85	13172	4
Loyal Hanna. Westmorland co		2·03	22·96	65·84	7·88	1·29		3
" " "		2·59	12·11	59·66	4·80	0·83		2
Lykens valley. Williamstown colliery		2·27	8·83	78·83	9·39	0·67		9
Lykens valley. Williamstown colliery		1·93	7·25	82·01	8·27	0·52		9
Lykens valley. R A.		0·68	5·19	84·34	9·62	0·16		2
Lloydell. Cambria co		3·19	12·50	80·50	3·72	0·11		3
" "		1·56	14·68	80·37	3·39	0·10		3
Mahony. Schuylkill		0·45	2·15	94·63	2·63	0·13		2
Mahony. Schuylkill. No. 2 colliery		3·57	0·90	86·85	8·49	0·18		2
Mammoth vein, Schuylkill coal		2·98	3·38	87·13	5·85	0·65		9
Manifold. Pittsburgh bed		1·37	37·10	53·84	7·69	1·61		4
Mapleton. Sewickley coal		1·50	30·42	55·04	11·63	1·40		9
Masontown. Sewickley coal		1·06	34·80	53·53	8·16	2·43		9
Meadowland Pittsburgh bed		1·90	36·20	53·70	8·20	1·52		4
Midland. Pittsburgh bed	1·60	2·06	34·79	51·95	11·20	1·93		4
Monongahela city. Redstone bed		1·06	33·59	48·68	14·29	2·36		9
" gas coal		1·95	32·88	57·50	7·67	2·88		3
Morea Middle Lehigh		0·97	1·11	93·99	3·79	0·13		2
" "		0·84	1·54	90·22	7·19	0·20		2
Morrisdale. Clearfield		1·94	14·19	77·32	6·07	0·46		3
Moshannon creek Clearfield		1·74	21·95	67·96	7·25	1·09		2
Mount Vernon. Houtzdale		2·04	17·40	74·20	5·64	0·71		3
Murdocksville. Ames bed		2·15	39·15	52·65	6·05	3·61		4
Natalie Shamokin district		0·48	11·13	79·23	9·02	0·12		2

UNITED STATES COALS *Continued.*

	Thickness of Seam.	Loss on air drying.	Moisture	Volatile combustible	Fixed Carbon.	Ash	Sulphur	Calorific Value in B.T.U.	Reference No.
New Pardee. Ratton			2·20	17·45	79·86	9·34	0·14		1
Nottingham mine. Pittsburgh bed			1·72	36·98	56·55	4·75	1·15		4
Old Victor. Clearfield co			1·13	14·32	82·20	2·21	0·13		1
Otto mine. R. A			0·80	4·86	84·57	9·53	0·23		2
Pardee, Cambria co			1·94	18·25	72·90	6·31	0·51		3
Pardee, Patton. Cambria co			5·68	28·84	61·66	3·48	0·32		1
" "			3·80	15·81	74·02	4·90	0·45		2
" "			1·94	18·25	72·90	6·31	0·51		3
" "			1·95	13·90	74·16	9·30	0·69		2
Paris. Pittsburgh bed			1·95	39·05	47·30	11·70	3·87		4
Philson coal bed, near Ursina			0·92	22·95	66·09	6·03	3·09		2
Pittsburgh bed. Blanche mine. Anderson			1·70	37·20	55·83	5·27	1·13	14335	4
Pittsburgh bed. Clinton			3·35	35·55	47·55	13·55	1·41		4
" Ellsworth, Coll. No. 1			1·22	36·28	56·24	6·26	0·84	14247	4
" Ellsworth, Coll. No. 2			1·05	36·65	57·25	5·05	0·91		4
" Ellsworth, Coll. Nos. 1 and 2		1·90	2·46	34·48	57·01	6·05	0·88	14013	5
Pittsburgh bed. Frankfort			2·51	35·49	50·15	11·85	3·24		4
"			1·54	38·21	48·57	11·68	4·12		4
" Greensburg, Jamison mine		2·20	3·15	30·27	56·17	10·41	1·26	13406	5
Pittsburgh bed Nottingham mine, Hackett			1·72	36·98	56·55	4·75	1·15		4
Pittsburgh bed London, S. H			2·48	38·74	49·18	9·60	1·85	13172	4
" Manifold mine			1·37	37·10	53·84	7·69	1·61		4
" Meadowlands, McLains mine			1·90	36·20	53·70	8·20	1·52		4
Pittsburgh bed Midland mine, No 3		1·60	2·06	34·79	51·95	11·20	1·95		4
" Paris			1·95	39·05	47·30	11·70	3·87		4

Pittsburgh mine, Warriors point		2·95	35·75	48·65	12·65	3·29	4
" Sodom S. H.	1·20	1·87	38·78	52·85	6·50	1·78	4
" No. 1		4·14	30·12	63·01	2·75	0·17	3
Platt coal bed, Berlin		1·00	18·17	53·52	21·92	5·38	9
Powellton coal		1·46	12·56	79·82	6·16	0·14	3
Powhattan coal		4·50	1·06	86·67	7·56	0·33	3
Price coal bed, Berlin		0·87	20·33	68·94	8·68	1·76	9
" Summerhill, Cambria co.		0·82	19·15	70·17	9·41	0·44	9
		0·55	17·32	61·63	19·46	1·03	9
Ratton, New Pardee coal		2·20	17·45	70·86	9·34	0·14	1
Redstone bed, Hackett, Russell mine		1·46	35·56	53·39	9·59	2·05	4
Redstone bed, Monongahela city		1·06	33·59	48·68	14·29	2·36	9
Rockhill, Robertsdale		2·97	13·38	80·28	3·42	0·62	3
Ryerson Sta. Washington bed	0·50	1·73	36·97	47·20	14·10	3·81	4
Salina Sta. Freeport upper bed		1·06	33·95	54·39	9·53	1·05	9
Schuylkill, Kohonoor Colliery No. 1		3·34	1·86	87·96	6·70	0·13	2
Schuylkill mammoth vein, Gilberton Colliery		2·98	3·38	87·13	5·85	0·65	9
Schuylkill, Mahony Colliery No. 1		0·45	2·15	94·63	2·63	0·13	2
" " No. 2		3·57	0·90	86·85	8·49	0·18	2
Sewickley coal bed, Mapleton		1·50	30·42	55·04	11·63	1·40	9
" " Masontown		1·06	34·80	53·53	8·19	2·43	9
Shamokin district, Natalie coal		0·48	11·13	79·23	9·02	0·12	2
Shawmut mine No. 1, Elk co.		2·65	29·45	62·40	5·20	1·76	3
Shawmut mine No. 2, Elk co.		2·54	27·00	61·92	8·54	1·96	3
" " Elk co.		2·68	32·06	61·67	3·59	0·28	3
Shenandoah, Schuylkill		0·80	1·06	85·25	11·81	1·08	2
Sodom, S.H. Pittsburgh bed	1·20	1·87	38·78	52·85	6·50	1·78	4
Somerset, Freeport upper bed		0·86	16·88	66·05	15·61	0·58	9
Sonoman		2·57	12·62	79·50	5·09	0·23	3
Summerhill, Price coal bed		0·82	19·15	70·17	9·41	0·44	9
		0·55	17·32	61·63	19·46	1·03	9
Twin Rocks, Big Bend		1·55	15·98	75·01	6·62	1·00	3
Urina, Philson coal bed		0·92	22·95	66·09	6·03	3·09	9
Warriors point, Pittsburgh bed		2·95	35·75	48·65	12·65	3·29	4
Washington bed, Ryerson Sta.	0·50	1·73	36·97	47·20	14·10	3·81	
" Washington co.		1·69	29·15	46·65	10·52	1·97	
Waynesburg bed, near Beallsville	1·40	1·48	33·62	48·01	17·19	3·27	4
" "		1·23	36·18	46·72	12·88	2·97	22

UNITED STATES COALS - *Continued*

	Thickness of Seam.	Split Volatile ratio.	Moisture	Volatile combustible	Fixed Carbon.	Ash.	Sulphur.	Calorific Value in B.T.U	Reference No
Waynesburg bed Jefferson Minors bank			1·23	33·13	49·11	14·81	1·70		9
Waynesburg bed. Carmichaels			1·17	35·61	49·72	11·20	2·27		9
" Carmichaels			1·03	38·30	48·96	8·96	2·72		9
" Durbin. Crab-apple mine		1·20	1·18	32·58	51·58	13·58	1·36		9
Waynesburg bed, near Waynesburg			1·61	36·49	48·93	12·97	3·51		4
" Zolarville		1·70	2·26	33·68	49·59	13·19	1·27		9
" "		1·30	1·22	32·23	46·55	20·00	4·51		4
Wilkesbarre			0·98	32·82	47·75	18·45	2·93		4
Williamstown colliery, Lykens Valley coal			3·47	3·67	83·97	8·64	0·25		2
Williamstown colliery, Lykens Valley coal			2·27	8·83	78·83	9·39	0·67		9
Williamstown colliery, Lykens Valley coal			1·93	7·25	82·01	8·27	0·52		9
Windber, Somerset co., Eureka mine, No. 31			0·68	5·19	84·34	9·62	0·16		2
Windber, Somerset co, Eureka mine, No. 31			1·10	15·80	75·69	7·41	1·49	14499	4
Wurtemburg, Gallitzin coal bed			0·59	16·61	76·76	6·40	0·91	14753	4
" "			1·94	39·26	55·82	2·24	0·72		9
Wyoming mine, W. A			1·93	40·12	55·60	1·49	0·83		9
Youghiogheny. Ocean mine No. 2			0·47	7·13	85·18	4·78	0·44		2
" " No. 1			2·41	29·69	64·94	2·94	0·02		3
Zolarville. Waynesburg bed		1·70	2·78	26·76	62·26	8·20	0·22		3
		1·30	1·22	32·23	46·55	20·00	4·51		4
Tennessee Coal—			0·98	32·82	47·75	18·45	2·93		4
Cripple creek, near Briceville			3·20	30·04	63·42	3·34	0·43		3

Fraterville			2 37	31 47	62 72	3 44	0 30		
Coal creek, near Knoxville			2 33	2 53	82 14	13 09	0 23		3
" near Knoxville			3 16	27 22	65 42	4 00	0 20		1
" Black Diamond mines			3 31	31 95	62 68	2 03	0 25		3
Oneida, Paint Rock coal			5 15	28 11	61 44	5 40	0 18		3
Mingo, Mingo coal			3 61	30 23	64 37	1 65	0 14		1
" "			3 51	27 96	62 08	4 66	1 74		1
Texas Coal									
Hoyt, Mines No. 1		5 80	24 48	38 17	28 94	8 41	0 53	8480	4
" Mines No. 2		25 80	10 66	39 42	40 11	9 81	0 71	9604	4
Thurber		...	5 67	32 93	49 43	12 07	0 64		3
Wooster Sta., south of Crockett		16 36	20 55	47 20	19 41	12 84	0 67	8534	4
		24 00	13 40	42 75	29 00	14 85	1 04	9358	4
		20 00	16 88	40 42	29 75	12 95	0 79	9083	4
Virginia Coal									
Crab Orchard. H. C. Morris Prospect		2 40	4 06	34 93	56 28	4 73	1 20	13826	5
Crab Orchard. Big opening, Wilson farm		1 90	3 35	35 13	55 94	5 58	0 92	13932	5
Darby. Darby mine, Lee county		2 00	4 35	36 80	54 43	3 33	0 79	13939	5
Dorchester			2 36	28 52	65 66	3 46	0 43		3
Stonega			2 20	30 65	63 78	2 37	0 1[illegible]		3
Looney creek			2 83	31 51	63 70	1 96	0 22		3
Toms creek. Coburn mine		2 20	3 05	31 65	60 82	4 48	0 67	14470	5
" Banner coal			1 25	28 78	64 60	4 15	0 12		2
" Banner coal		..	1 32	29 20	64 51	3 80	0 16		2
West Virginia									
Acme. Keystone mine		2 10	2 82	32 20	[illegible]	8 03	1 38	13766	5
Ansted. Gauley Mountain mine		2 60	1 00	32 12	58 92	7 36	0 92	14153	4
Big Sandy, Big Sandy mine		1 10	0 62	18 05	74 [illegible]	6 95	0 60	14743	4
Bretz. Bretz Mine		0 50	0 98	28 72	61 87	8 43	0 90	14129	4
" No. 2 mine, Elkins Coal Co.		2 60	3 91	26 68	79 70	10 11	1 [illegible]	13370	5
" 2½ mile from Bretz		2 50	3 46	27 29	63 16	8 12	1 [illegible]	13809	5
Clarksburg. Ocean mine		9 00	2 01	37 51	52 13	8 [illegible]	2 54	13841	[illegible]
" Pittsburg mine		0 50	1 46	40 14	50 [illegible]	7 90	2 50	13860	4
Coalton. Coalton mine		0 80	0 65	29 29	59 97	10 18	[illegible]	13[illegible]	4
Colliers. Pittsburgh bed	4' 7"	2 80	2 33	35 97	51 93	11 77	2 82		4
Elk Garden. West Virginia Mineral Co.			1 11	11 68	80 67	6 45	0 09		1
Glen Alum. Glen Alum mine		1 60	2 86	33 23	58 08	5 83	0 67	14106	5

UNITED STATES COALS—*Continued.*

	Thickness of seam.	Loss on air drying.	Moisture.	Volatile combustible.	Fixed carbon.	Ash.	Sulphur.	Calorific value B.T.U.	Reference No.
Kingmount. Kingmount mine		0.90	1.35	36.92	55.36	6.37	0.90	14164	4
McDonald. McDonald mine		2.30	2.96	22.74	69.29	5.01	0.89	14425	5
Monongha. Monongha mine No. 6		4.10	5.57	31.61	54.45	8.37	1.20	13663	5
Mora. Mora mine		1.10	0.65	18.80	75.92	4.63	0.57	15190	4
New River. Fayette county			1.85	18.93	71.06	[illegible]	0.18		2
Page. Fayette county, Mine No. 2		2.60	3.74	31.04	61.31	3.91	0.89	14436	5
Page. Fayette county, Mine No. 1		3.10	5.00	29.07	62.57	3.27	1.03	14110	5
Phillippi			2.54	26.12	64.76	6.58	0.89	...	3
Pocahontas. McDowell county		.....	1.02	13.59	80.10	5.15	0.14		1
Powellton. Vulcan mine		3.10	1.01	29.53	62.67	6.79	0.80	14371	4
Richard. Richard mine		1.30	1.00	30.25	58.38	10.37	1.07	13796	4
Rush Run. Rush Run mine		0.90	0.64	21.74	72.53	5.09	0.66	14942	4
Summerville. Summerville bed	4′ 2″	5.00	2.00	30.15	59.57	8.28	0.75		4
" "		3.40	2.11	29.14	62.27	6.48	0.09		4
Sun. Sun mine No. 1		3.20	0.76	20.54	73.61	5.09	1.20	14857	4
Thomas			1.87	21.21	71.28	5.54	0.15		3
Winifrede. Gas mine		2.10	3.57	36.38	55.20	4.85	1.32	14048	5
Zalia. Rogers coal bed	3′-0″	4.00	2.56	35.29	51.82	10.33	5.25		4
" Lindsey bed	3′-7″	2.90	1.29	37.86	51.40	9.45	5.25		4
Zenith. Zenith mines No. 1 and 2		2.50	0.80	16.90	70.80	11.50	[illegible]	13970	4
Washington Coals.									
Bellingham bay		...	8.39	15.50	33.26	12.66		...	7
Black Diamond near Seattle		....	8.36	31.24	56.09	4.17	0.14	...	4
" Mine No. 2		....	4.10	40.90	50.73	4.27	0.76		6
" Morgan slope		.....	4.32	43.18	49.81	2.69	0.47	....	6
" Mine No. 14		....	6.28	41.22	50.30	2.50	0.39		6
Blue canyon. Whatcom county		....	3.62	29.65	62.75	3.68	0.51		
Carbonado. No. 4 vein		....	1.02	37.02	49.12	12.84	0.0	....	6
" No. 8 vein		....	1.16	35.87	57.88	5.09	1.32	.....	6

Carbonado, North Evein	1 34	35 22	56 67	6 77	1 43	6
Claquato, Lewis mine	1 21	8 39	72 50	18 10	0 98	6
Cokedale	0 53	26 67	64 54	8 26	0 68	6
Elk Horn, Lewis county	3 25	1 94	77 95	17 [illegible]	0 23	1
Fairhaven, Skagit county	2 10	20 47	62 30	14 89	0 44	1
" "	4 98	33 03	59 08	2 93	0 24	[illegible]
Franklin, near Seattle	7 73	30 41	46 67	15 18	0 30	[illegible]
" "	1 47	[illegible]	[illegible]	2 88	[illegible]	1
" "	4 70	33 86	[illegible]	[illegible]	[illegible]	[illegible]
Green River coal	2 96	[illegible]	[illegible]	4 01	[illegible]	6
Issaquah, King co., Bryant coal	17 38	[illegible]	46 27	[illegible]	0 21	[illegible]
New Castle, Vein No. 4 near Seattle	16 91	[illegible]	[illegible]	[illegible]	0 16	[illegible]
Renton, Occident mine, vein No. 10	3 00	[illegible]	[illegible]	[illegible]	[illegible]	6
" vein No. 6	2 02	[illegible]	[illegible]	[illegible]	[illegible]	6
" vein No. 5	1 51	[illegible]	[illegible]	[illegible]	[illegible]	6
" vein No. 4	2 50	[illegible]	[illegible]	[illegible]	[illegible]	6
" vein No. 3	4 60	27 80	[illegible]	[illegible]	[illegible]	6
" vein No. 1	4 06	32 78	[illegible]	[illegible]	[illegible]	6
" Co-operative Coal Co., vein No. 1	[illegible]	37 80	[illegible]	10 65	[illegible]	[illegible]
Renton, Co-operative Coal Co., vein No. 2	1 02	[illegible]	47 92	[illegible]	[illegible]	[illegible]
Renton, Co-operative Coal Co., vein No. 2	3 74	37 [illegible]	[illegible]	[illegible]	[illegible]	6
Roslyn, New Dip No. 2 mine	2 08	38 22	[illegible]	[illegible]	[illegible]	6
" Ole Ham opening	6 [illegible]	37 [illegible]	[illegible]	[illegible]	[illegible]	6
" Ole Ham coal	2 [illegible]	44 70	[illegible]	[illegible]	[illegible]	[illegible]
" Shaft No. 4	1 90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" from car load	5 02	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" coal sampled at Victoria	2 90	31 00	[illegible]	[illegible]	[illegible]	[illegible]
" coal steam [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" "	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" "	3 42	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Seattle, from vicinity of	11 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"	11 00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"	4 16	44 84	[illegible]	[illegible]	[illegible]	[illegible]
Tacoma, vicinity of	2 13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wilkeson, Pierce co.	1 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" Mine No. 7	0 42	[illegible]	[illegible] 42	12 [illegible]	[illegible]	[illegible]
Mine No. 3	0 5[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

UNITED STATES COALS *Continued*

	Thickness of Seam	Loss on air drying	Moisture	Volatile combustible	Fixed Carbon	Ash	Sulphur	Calorific Value in B.T.U.	Reference No.
Wilkeson, Mine No. 2			1·02	26·72	63·82	6·44	1·90		6
" Mine No. 1			0·63	28·11	61·53	9·73	2·09		6
Wyoming Coal –									
Aladdin. Stillwell mine		2·90	15·12	34·36	33·86	16·70	6·66	8928	5
Cambria. Antelope Mines 1 and 2		4·50	8·93	36·52	33·76	20·79	4·03	10001	5
" " "		6·90	2·73	37·61	37·41	22·26	4·17	10364	4
" " "		6·00	17·69	37·96	39·56	4·79	0·63	10355	4
Sheridan. Monarch mine			5·43	37·17	53·61	3·19	0·41	...	3
Kimmerer mine No. 1			5·92	34·73	54·21	5·14	0·41		3
Kimmerer mine No. 4									

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CANADA

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243. Guysborough, Antigonish, Pictou, Colchester and Halifax counties, by Hugh Fletcher and E. R. Faribault. 1886.
331. Pictou and Colchester counties, by H. Fletcher. 1890-1.
358. South-western Nova Scotia (preliminary), by L. W. Bailey. 1892-3. Map No. 362, scale 8 m. = 1 in.
628. South-western Nova Scotia, by L. W. Bailey. 1896. Map No. 641, scale 8 m. = 1 in.
685. Sydney coal-field, by H. Fletcher. Maps Nos. 652, 653, 654, scale 1 m. = 1 in.
797. Cambrian rocks of Cape Breton, by G. F. Matthew. 1900.
871. Pictou coal-field, by H. S. Poole. 1902. Map No. 833, scale 25 ch. = 1 in.

MAPS.

1042. Dominion of Canada. Minerals. Scale 100 m. = 1 in.

YUKON.

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894. Sketch Map Kluane Mining district, scale 6 m. = 1 in.
916. Windy Arm Mining district, Sketch Geological Map, scale 2 m. = 1 in.
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1010. Coal Areas of Peace and Athabaska rivers, scale [illegible]

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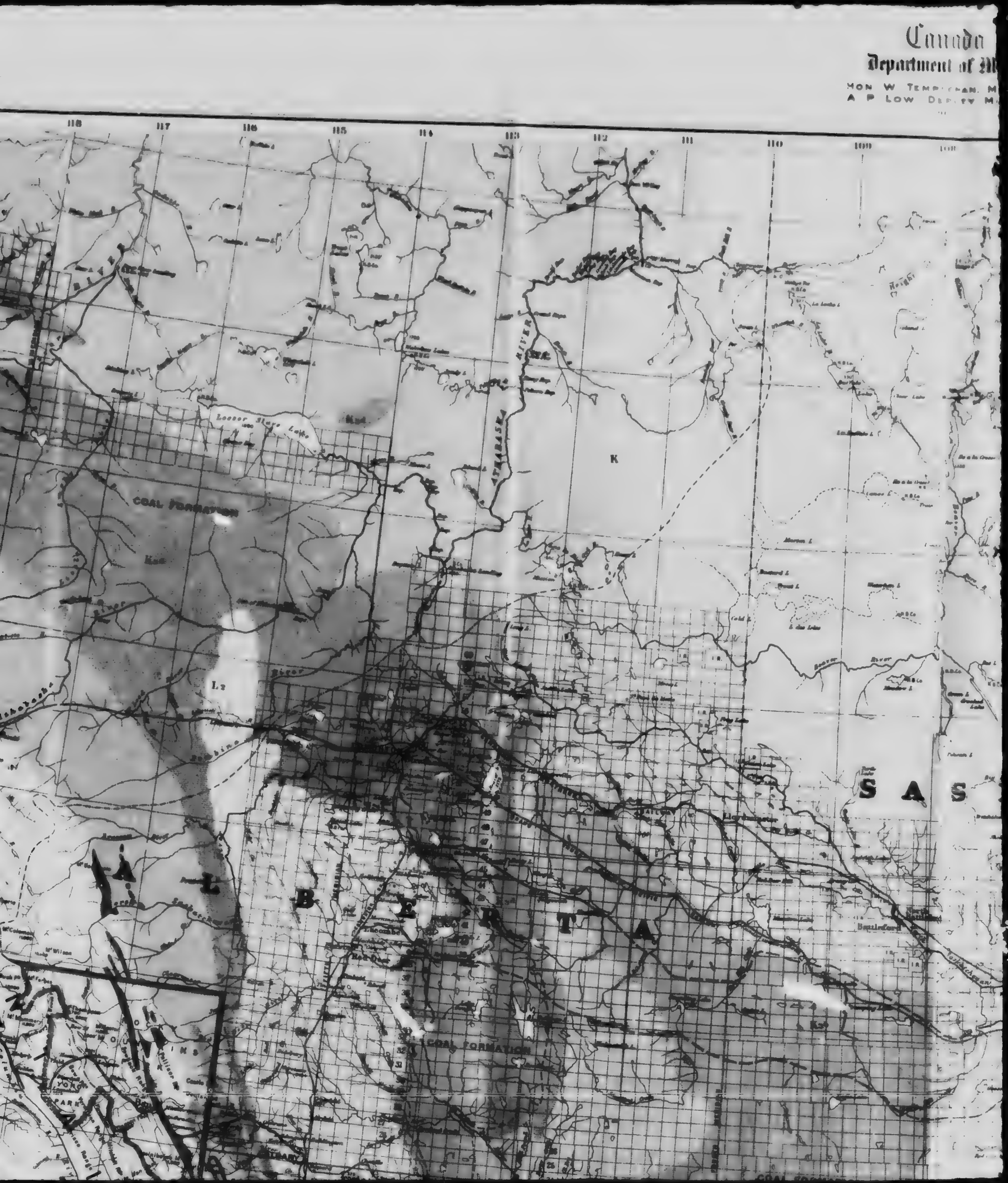
COAL FORMATION	Kael	Edmonton Series	Cretaceous	K
COAL FORMATION	Kab	Bella River Coal Formation		
COAL FORMATION		Kootanie Coal Formation		

Coal outcrops

Geological boundary

Undetermined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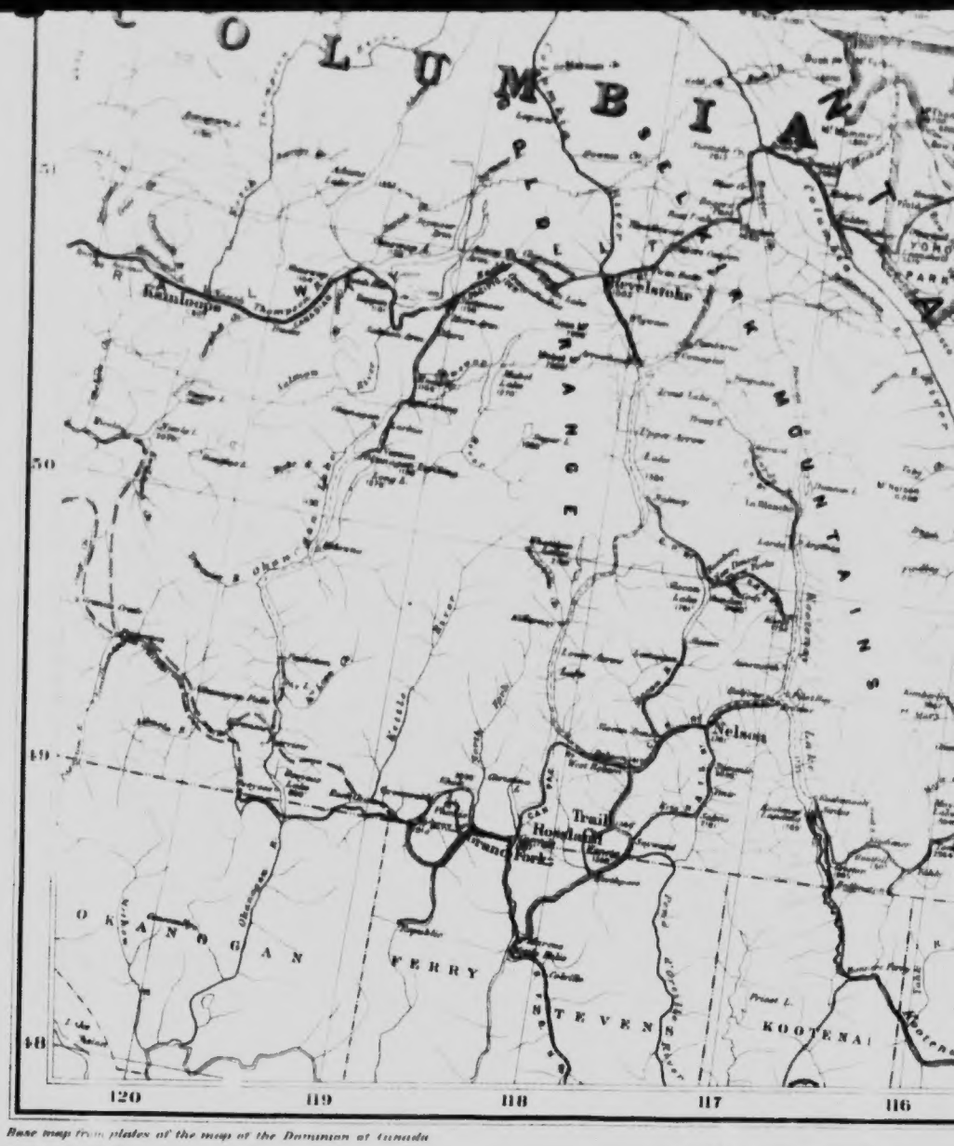

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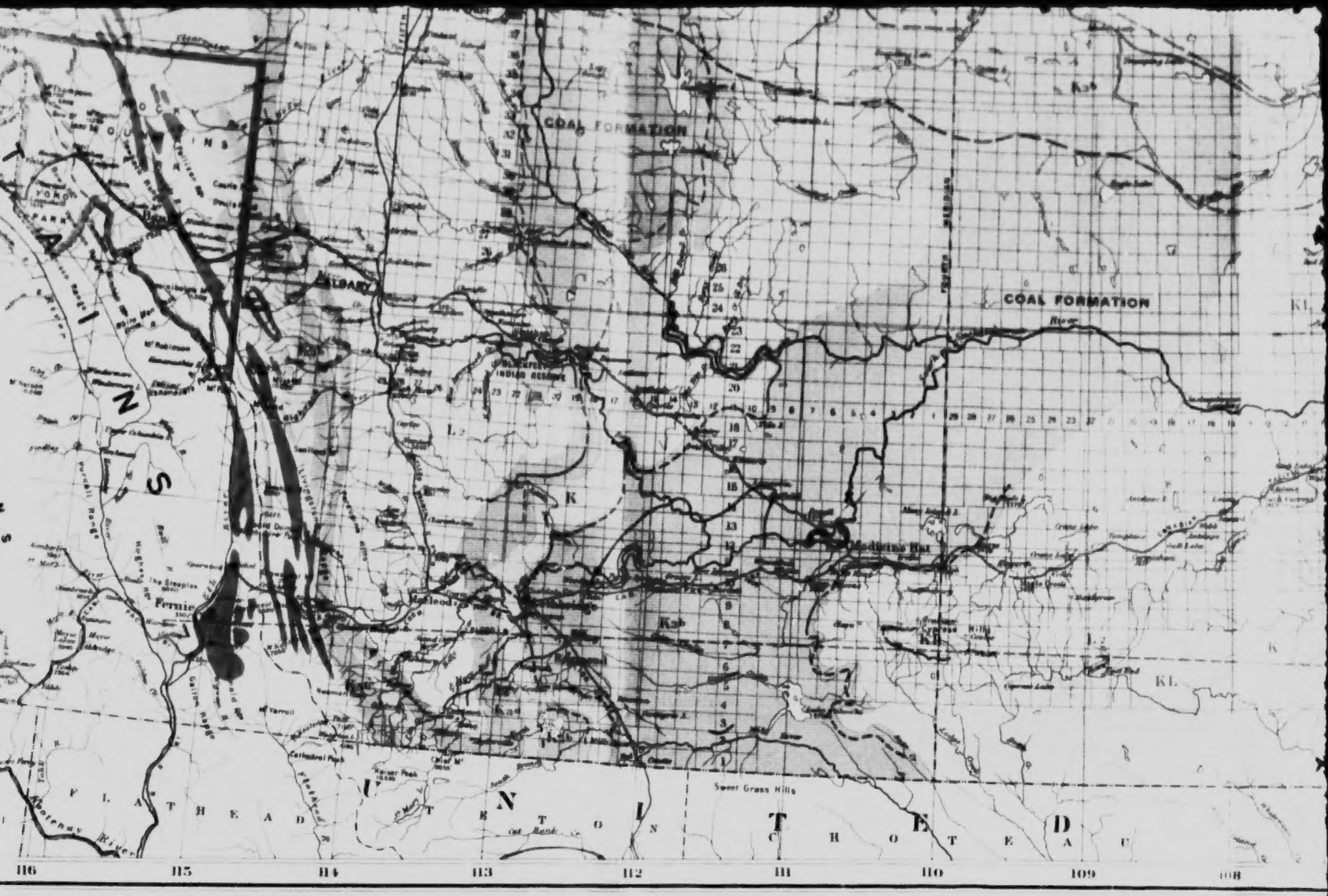
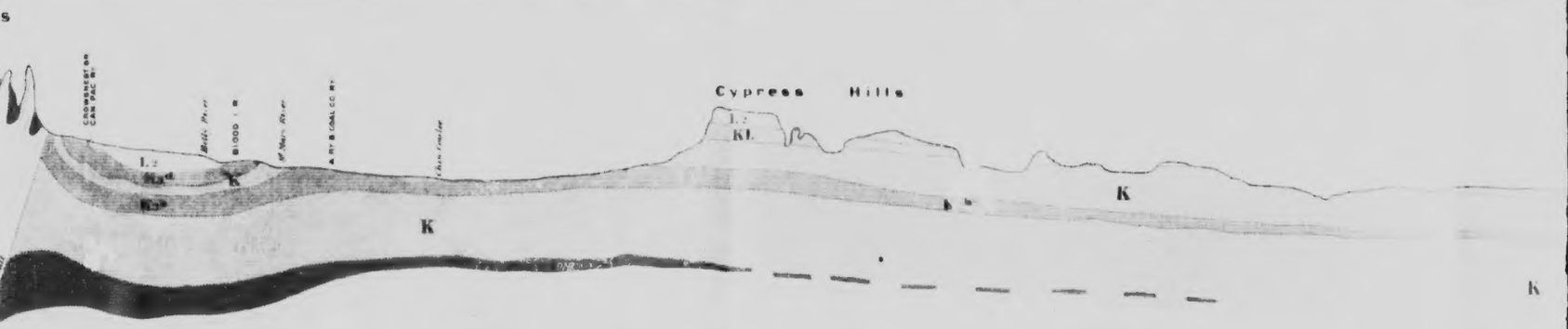




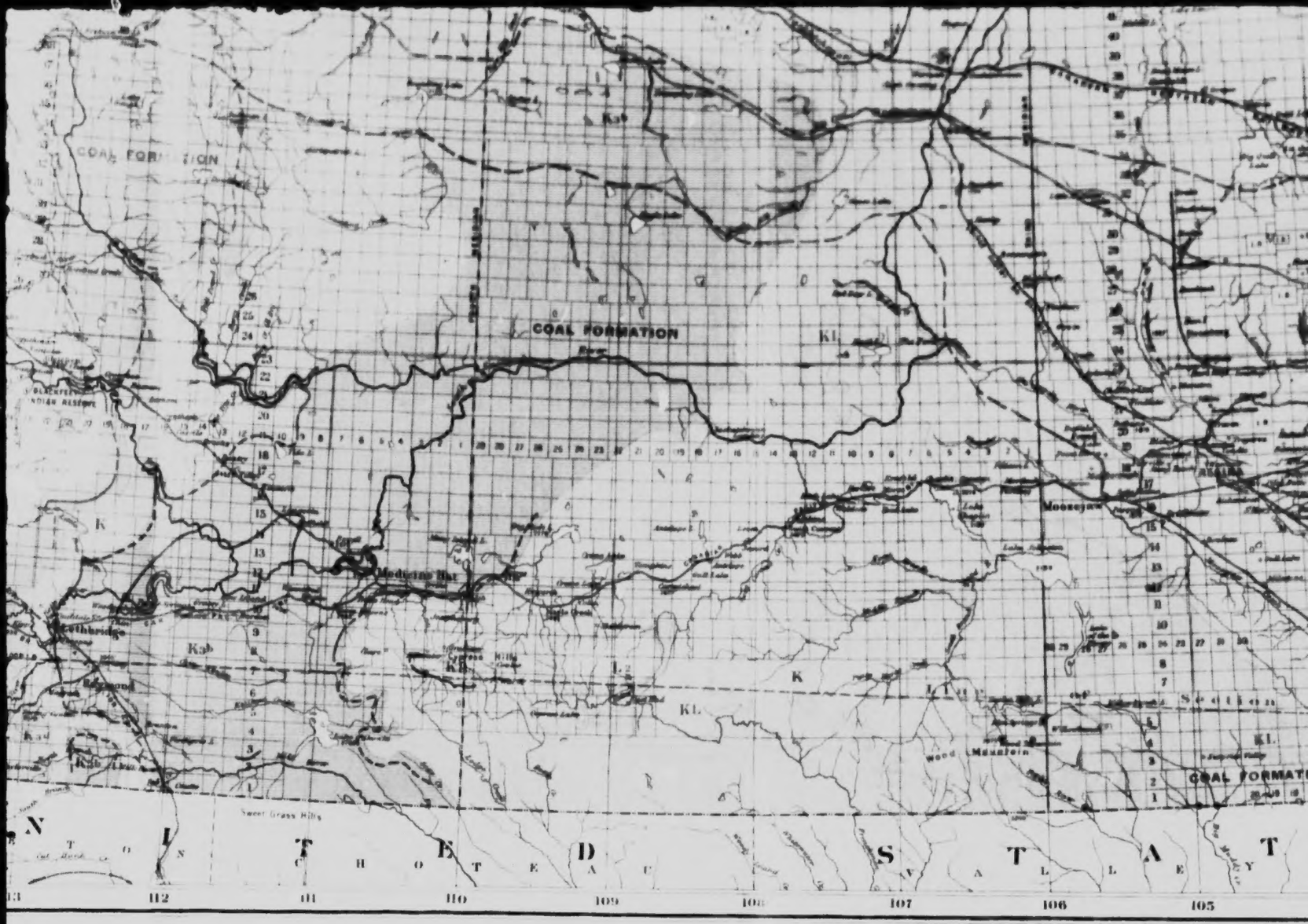
Diagrammatic section along line

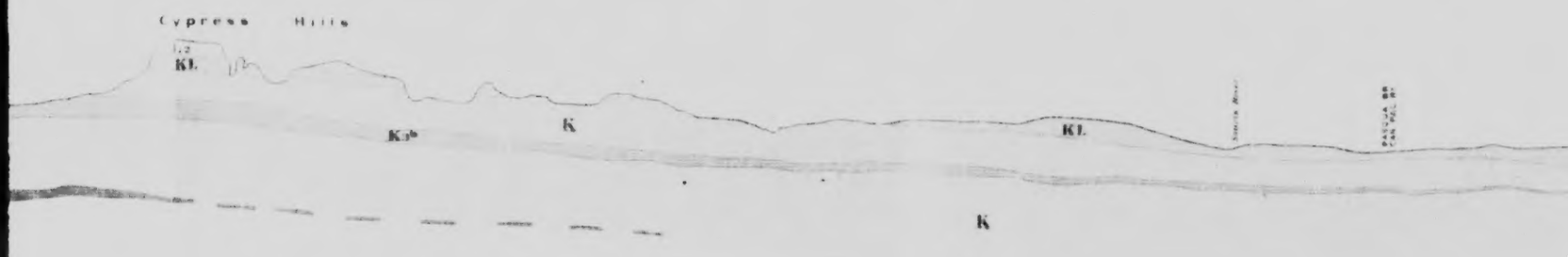
Geological Map
showing
COAL AREAS
in
ALBERTA, SASKATCHEWAN

by
D. B. DOWLING, B.A.Sc.
1906

Scale, 35 statute miles to 1 inch

25 0 25 50 75





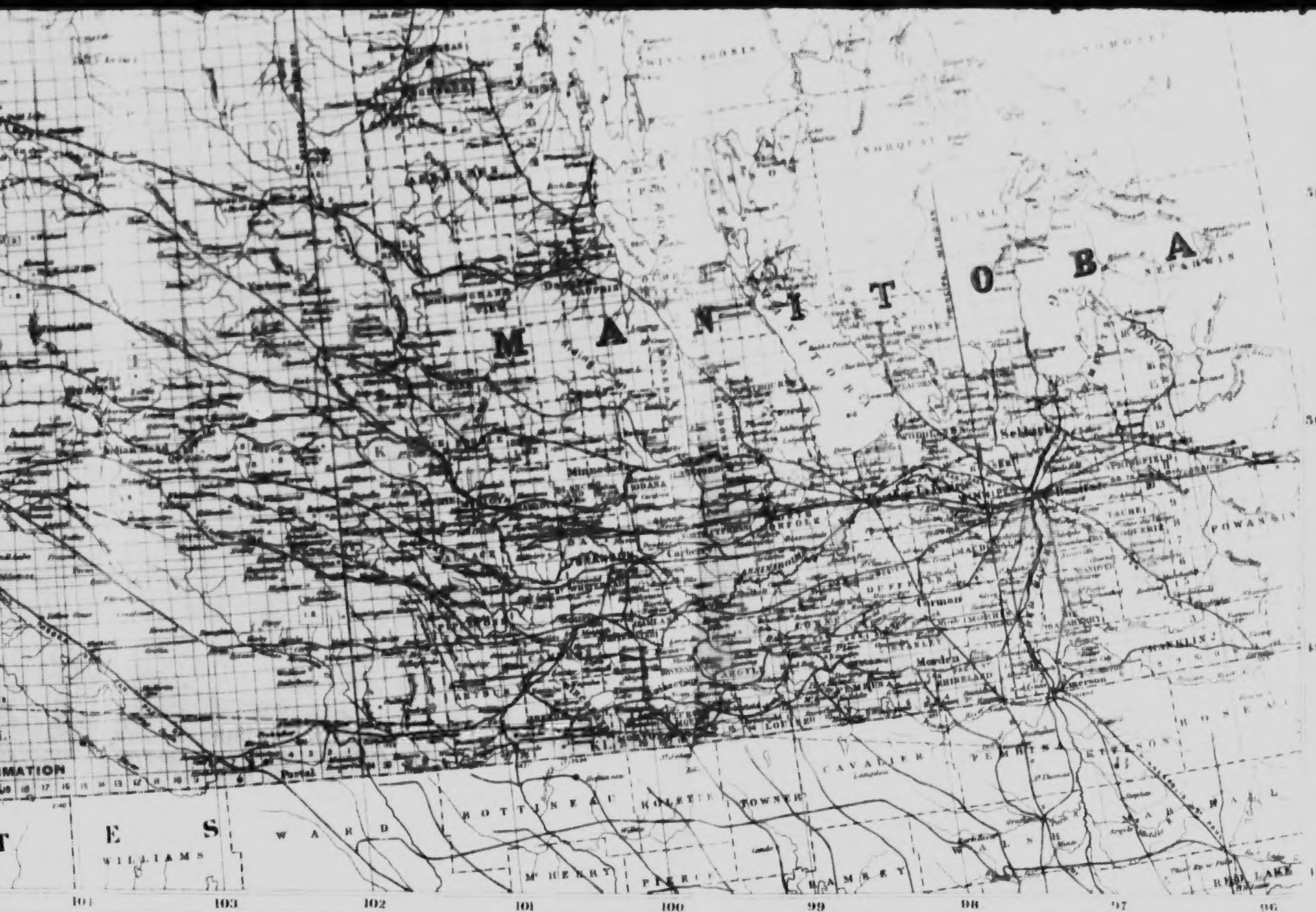
Diagrammatic section along line A—B

Geological Map
shewing
COAL AREAS
in
ALBERTA, SASKATCHEWAN AND MANITOBA

by
D. B. DOWLING, B.A.Sc.
1906

Scale, 35 statute miles to 1 inch 1/2,230,400

25 0 25 50 75 100 125 150



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